SANTA CLARA COUNTY FLOOD CONTROL

AND

WATER DISTRICT

SUMMARY OF DAM AND RESERVOIR INVESTIGATIONS IN SANTA CLARA COUNTY

11

1972

TC
557
C2 S383
1972
c.6
LIBRARY

istrict Library [illegible] (1-5-94)

TC557C2 S383 1972 c.6

SANTA CLARA COUNTY FLOOD CONTROL
AND
WATER DISTRICT

SUMMARY OF DAM AND RESERVOIR INVESTIGATIONS
IN
SANTA CLARA COUNTY

by

CARROLL CHURCH
Office Engineer

DISTRICT BOARD OF DIRECTORS

Maurice E. Dullea, Chairman

Joseph Chiri
Victor E. Corsiglia, Sr.
James J. Lenihan

Robert T. Sapp
R. Jack Sturla
Frank A. Wilcox

DONALD K. CURRLIN
General Manager

LLOYD C. FOWLER
Director of Engineering

1972

TABLE OF CONTENTS

Page

Introduction iv

Dam and Reservoir Site on Arastadero Creek. 1

Dam and Reservoir Site on Arroyo De Los Coches. 3

Dam and Reservoir Site on Bodfish Creek 5

Dam and Reservoir on Calabazas Creek. 6

Calero Dam and Reservoir Enlargement Project. 8

Enlargement of Chesbro Dam and Reservoir
   Llagas Creek Watershed, 1962 Report. 12
   Llagas Creek Watershed, 1967 Report. 14

Enlargement of Existing Chesbro Dam and Reservoir 15

Coast Stream Water Supply for Palo Alto 16

Dam and Reservoir Sites on Coyote Creek 20

Dam and Reservoir Site on Coyote Creek 22
   (S.C.C.F.C. & W.D. Study)

Dam and Reservoir Site on Guadalupe Creek 25
   (New Guadalupe Dam and Reservoir)

Dam and Reservoir Site on Guadalupe Creek 29
   (Second Dam and Reservoir on Guadalupe Creek)

Dam and Reservoir Site on Little Arthur Creek 31

Dam and Reservoir Site on Matadero Creek 32

Dam and Reservoir Site on Pacheco Creek 34
   (Pacheco Creek Dam Site)

Dam and Reservoir Site on Pacheco Creek 37
   (Harper Canyon Dam and Reservoir)

Dam and Reservoir Site on Pacheco Creek 38
   (Report for Pacheco Pass W.D.)

Page

Dam and Reservoir Site on Pascadero Creek 40
(Investigation of Pascadero Creek as a Source of Water for Palo Alto)

Dam and Reservoir Site on Penitencia Creek. 43
(A study of Feasibility of a Dam Site on Penitencia Creek)

Dam and Reservoir Site on Penitencia Creek. 45
(Penitencia Creek Dam and Reservoir)

Dam and Reservoir Site on Penitencia Creek 47
(Report by University of California)

Dam and Reservoir Site on Penitencia Creek 49
(Penitencia Creek Flood Control and Water Conservation Investigation)

Dam and Reservoir Site on Permanente Creek. 52

Dam and Reservoir Site on San Francisquito Creek. 54
(Alternative Method of Flood Control - San Francisquito Creek, California)

Dam and Reservoir Site on San Francisquite Creek. 57
(Ladera Dam and Reservoir)

Dam and Reservoir Site on San Francisquito Creek. 63
(Review of C. of E. Report on San Francisquito Creek by R. K. Linsley)

Dam and Reservoir Site on San Francisquito Creek. 66
(Little Francis Project)

Dam and Reservoir Site on San Francisquito Creek 68
(Stanford University Dam and Reservoir)

Dam and Reservoir Site on San Tomas Creek 69

Dam and Reservoir Site on Silver Creek. 71
(Estimate of the Construction Cost of the Proposed Silver Creek Dam)

Page

Dam and Reservoir Site on Silver Creek 72
(Silver Creek Dam and Evergreen Distribution System)

Dam and Reservoir Site on Silver Creek 74
(Evergreen Reservoir)

Dam and Reservoir Site on Soquel Creek 75

Dam and Resevoir Studies Related to District's South County Planning Study. 78

Dam and Reservoir Site on Stevens Creek 82

Dam and Reservoir Site on Timber Creek 84

Proposal to Raise Existing Uvas Dam 90
(Corps of Engineers' Study)

Dam and Reservoir Site on Uvas Creek 91
(Gilroy Dam - Multipurpose Project)

Dam and Reservoir Site on Uvas Creek 95
(Uvas and Llagas Creek Project)

Dam and Reservoir Site on Uvas Creek. 98
(Lower Uvas - Los Gatos Creek Project)

Dam and Reservoir Site on Uvas Creek 101
(Study by Blackie & Wood)

Dam and Reservoir Sites on Uvas and Llagas Creeks - 103
Feasibility Report - Utilization of Surplus Water From Upper Llagas and Uvas Creeks

Dam and Reservoir Site on Zayante Creek - Zayante Project . . . 107

Appendix 110

INTRODUCTION

The primary source of water supply in Santa Clara County for agricultural and urban use has been from the groundwater basins of the area. These basins are replenished by rainfall and runoff from tributary streams. Surface reservoirs have been constructed on some of the tributary streams to store seasonal flood runoff for later release to groundwater recharge areas. This conservation of flood flows on tributary streams has greatly increased the amounts of water recharged to the major groundwater basins of the County and at the same time provided some degree of flood protection and water-related recreation. The need for additional water supplies, flood protection, and water recreation continues to grow in Santa Clara County with increasing population, and the potential for meeting these needs through the construction of dams and reservoirs has been investigated by a number of governmental agencies over the years.

In the interest of providing a summary of the water supply and flood control investigations involving a dam and reservoir, an extensive search was made to locate published reports, completed investigations that were not published, and on-going investigations. Upon review of these reports it became apparent that a wide range of investigative detail was employed in evaluating a project and its economic feasibility. Some studies were very preliminary and no attempt was made to adequately define the hydrology, reservoir yields, topography and geology of the site, construction details, project costs or the allocation of costs to other purposes and benefits. Other studies were quite comprehensive single purpose and multipurpose evaluations of the potential dam and reservoir project. The information in each report was summarized and if a study considered several dam and reservoir projects in detail as part of a regional investigation, a separate summary was prepared for each project. Where information was limited the separate sites studied were summarized in a single summary. If alternative sites were considered for a particular project, these were all included in a single summary.

The summary of the project reviews is bound in this volume. In general, these summaries contain:

1. Name of project, author, and date of study
2. Name and author of supporting investigations
3. Detail of investigation
4. Purpose and general description of project
5. Summary of hydrology
6. Summary of dam and reservoir design criteria
7. Summary of design criteria for other purposes

8. Summary of geologic investigation
9. Summary of construction and annual costs
10. Summary of cost allocation
11. Summary of benefits and economic justification
12. Proposals for financing
13. Conclusions
14. Recommendations

Where construction and annual costs were established, these costs were based on prices at the time of study. In consideration of today's higher construction costs and interest rates, estimates of updated construction and annual costs for certain projects were made by the District, based on the appropriate E.N.R. construction cost index (print-bound in appendix) and today's higher interest rates. Based on this updated information, the economic feasibility was reassessed and conclusions discussed at the end of the summary report under the heading, "Comments". In addition, other observations of the District were summarized in this section, including the District's evaluation of the project and recommendations for a restudy of sites that may be economically feasible to develop if cost allocation to other purposes and today's values of benefits are considered.

Except for the investigations conducted by the District, the enclosed summaries, excluding the comments section, are based on studies, conclusions, and recommendations made by others. Only District investigations and statements contained in the comments section of each report are based on District evaluations.

DAM AND RESERVOIR SITE ON ARASTADERO CREEK

The name of this project is "Damsite Investigation on Arastadero Creek". The study was done by Jones Themm and Associates for the Los Altos Hills Golf and Country Club in October of 1958. The engineering and geologic investigation was preliminary in scope. The purpose of this investigation was to study geologic conditions at the site and establish design criteria for constructing a 25 foot high dam and reservoir for supplying irrigation water to the Palo Alto Hills Golf and Country Club.

The exact location of the dam and reservoir was not given.

The project would consist of an earthfill dam, concrete lined spillway and gated outlet works.

The geologic investigation consisted of the drilling of 5 test holes (3 along the dam axis and 2 in the reservoir area), the logging and interpretation of core samples and the testing of samples for engineering properties. The strata encountered was consolidated alluvia with 5 feet of top soil (to be removed for dam construction). Materials are adequate to support the dam and some settlement is expected in the upper layers. In addition, some seepage can be expected in the foundation soils and the abutments will require special treatment, possibly an impervious blanket on both abutments and pressure grouting on the southwest abutment. A downstream toe drain system was recommended to collect seepage flows. Suitable construction materials exist at the reservoir site.

Hydrology: - No data given.

Dam and reservoir design criteria:

1. Type of dam - earthfill dam - homogeneous fill (no core).
2. Height of dam - 25 feet
3. Side slopes of dam - 2 to 1 upstream and 3 to 1 downstream.
4. Crest width - 15 feet
5. Dewatering wells upstream of dam are needed during construction.
6. Crest length ± 325 feet.

Cost: - No data provided.

Conclusions: The site is acceptable for the construction of a 25 foot high dam and construction materials are available at the site. Reservoir leakage losses will be low and seepage through the abutments (with the impervious blankets) should also be low.

Comments: No information was provided on runoff, size of reservoir, reservoir yield and costs. Considering the high cost of land in this area and the possible low yield from a facility of this size it does not appear that this project would be feasible as a water supply facility. For the same reason it may be difficult to consider this for flood control and recreation purposes.

DAM AND RESERVOIR SITE ON ARROYO DE LOS COCHES

The name of this project is "Air Point Dam and Reservoir". The investigation was done by the State Department of Water Resources and was part of the California Water Plan submitted in Bulletin No. 3 in 1957. The initial study was preliminary and after a detailed geologic investigation of the dam site during the design of the South Bay Aqueduct the project was abandoned. The purpose was to establish the engineering and economic feasibility of constructing a terminal storage facility for the South Bay Aqueduct on Los Coches Creek.

The dam site was located on Los Coches Creek about 2 miles East of Milpitas.

The project consists of an earth fill dam, concrete lined chute type spillway and combination inlet-outlet works with control gates.

Based on a detailed geologic exploration at the dam site it was found that 1) The rock is highly weathered, soft and traversed by sear zones, 2) A fault runs through the dam site, 3) Extensive grouting is required and 4) Seismic problems are great. A dam to the height proposed could be built but special considerations would have to be worked out and costs would be high (about $20,000 per acre foot).

Hydrology:

This information is not available.

Dam and Reservoir Design Criteria:

a) Type of dam - earthfill with rock facing.

b) Height of dam - 165 ft.

c) Reservoir storage capacity - 3500 AF

d) Land required - 669.5 Ac.

e) Max. water surface elev. - 515 ft.

Costs:

Dam and Res.	$3,534,000
Pipeline	1,250,000
Relocations	400,000

Right-of-way	$1,568,000
Total	6,752,000

The above costs are based on 1962 prices and may be low considering the very poor dam site geology. The total cost based on 1970 prices is about $10,700,000.

Two alternative sites based on a smaller storage capacity were considered, one was an 810 acre foot reservoir on the North branch of Los Coches Creek and a second (Site No. 2) adjacent to the South Bay Aqueduct north of Los Coches Creek (700 AF reservoir). The cost of the North branch site on Los Coches Creek was $3,954,000 and for Site No. 2 was $2,564,000. These sites were considered uneconomic and the final site selected was a steel storage tank at the District's proposed Penetencia Water Treatment Plant site.

Mr. D. Finlayson, State Department of Water Resources, was not able to locate any additional information on this project in the State files.

DAM AND RESERVOIR SITE ON BODFISH CREEK

This dam and reservoir site was one of the alternatives considered by the Corps of Engineers in their Pajaro River Basin Study. The engineering and geologic studies were preliminary in scope. The purpose was to establish the engineering and economic feasibility of constructing a dam and reservoir on Bodfish Creek for flood control and water conservation.

The project consisted of an earthfill dam, concrete lined spillway and gated outlet works.

REMARKS: Additional information on hydrology, design criteria and costs was not found at the Corps of Engineers office in San Francisco.

The project was not found to be economically feasible and was eliminated from further consideration.

DAM AND RESERVOIR SITE ON CALABAZAS CREEK

This project is called "Calabazas Creek Dam and Reservoir and Saratoga Creek Diversion". The feasibility study was made by the Santa Clara Valley Water Conservation District and was completed in March 1956. This project was revised in 1956. The engineering and geologic analysis was preliminary in scope. The purpose of this study was to establish the engineering and economic feasibility of constructing a storage facility on Calabazas Creek for the conservation of local runoff from Calabazas and Saratoga Creeks and flood control on Calabazas Creek (a secondary purpose). Recreation was mentioned but not considered as a purpose.

The initial storage facility was located on Calabazas Creek near the intersection of Pierce Road and Via Regina and the revised site was located about 0.6 miles below the junction of Pierce and Mt. Eden Roads. The initial diversion dam on Saratoga Creek was located at elevation 800 feet and the pipeline and canal diversion would divert water directly into the main reservoir. The revised diversion dam would be located near the intersection of Pierce and Congress Spring Roads and water would be diverted through a 2,500 foot tunnel and discharged into Calabazas Creek above the proposed reservoir.

The project would consist of an earthfill dam on Calabazas Creek, a concrete lined chute type spillway, gated outlet works, diversion dam on Saratoga Creek and diversion facility (pipe and canal in the initial project and tunnel in the revised project). Road and structure relocations are also included.

Hydrology:

	Initial Project	Revised Project
Drainage area		
Calabazas Creek	2.51 square miles	2.06 square miles
Saratoga Creek	6.8 square miles	6.8 square miles
Average Annual Yield	1,050 A.F.	1,050 A.F.

Dam and Reservoir Design Criteria

Type of Dam	Initial Project	Revised Project
Main Dam	earthfill with rock facing	earthfill with rock facing
Diversion Dam	-	-
Height of Dam	131 feet	148 feet
Crest Length	1,675 feet	490 feet
Spillway Capacity	3,000 cfs	3,000 cfs
Freeboard	15 feet	-
Diversion Fac. Cap.	800 cfs	800 cfs
Reservoir Capacity	5,000 A.F.	5,000 A.F.

The geologic investigation was preliminary in scope and it was determined that the sites were acceptable and adequate construction materials exist at the site.

The main dam and diversion from Saratoga Creek would be operated for conservation and any resulting reduction in peak flow was considered a flood control benefit (benefits were not established). Stored water would be released into Calabazas Creek for recharge purposes with a portion diverted back into the Saratoga Creek channel through the Saratoga-Calabazas Creek pipeline. It was estimated that the flood peaks would be substantially reduced on Calabazas Creek; however, little benefit would be obtained on Saratoga Creek.

The total construction cost for the initial site based on 1955 prices was $2,500,000 for the main dam and $800,000 for the Saratoga-Calabazas Creek Diversion. This total cost of $3,300,000 escalated to 1970 prices is about $6,100,000. The lower or revised site was estimated to be about $1,000,000 cheaper.

Recommendation: Considering the large cost difference between the two project sites the lower or revised site was recommended for development.

Comments: Although flood control was considered and recreation mentioned these were not included as project purposes and no attempt was made to establish benefits or allocate costs. Considering the low average annual yield of 1050 acre feet, it does not appear that this is a feasible project for water conservation. In addition, it may not be possible to economically justify the project considering other benefits (flood control and recreation).

CALERO DAM AND RESERVOIR ENLARGEMENT PROJECT

The name of this project is "Calero Reservoir Enlargement Project". The engineering and economic feasibility study was done by Tudor Engineers for the District in December 1967. A separate geological and engineering investigation (first phase) was completed by Soil Mechanics and Foundation Engineers in February 1966. These investigations were of the detail needed for economic justification.

The purpose of this study was to establish the economic and engineering feasibility of enlarging Calero Dam and Reservoir for water supply, recreation and fish enhancement purposes. As a water supply facility, this enlarged reservoir would store additional water diverted from Almaden Reservoir, provide storage space for an emergency water supply and be operated as a terminal storage facility for the District's In-County Water Distribution System. In addition, this project would provide for a park facility around Calero Reservoir and support fish life. The expected increase in flood control benefits was considered to be very small and this purpose was not included.

In 1967 the engineering economic feasibility report was submitted to the State Department of Water Resources in support of the District's application for Davis-Grunsky construction grants.

The project is located on Calero Creek at the site of the existing dam and reservoir. This facility is within the City of San Jose near the intersection of Bailey and McKean Roads.

The project consists of the raising of main and auxiliary dams to elevation 520 feet (earthfill on the downstream face of main dam and earthfill on both faces of the auxiliary dam), a concrete lined uncontrolled spillway utilizing the existing spillway chute, a gated outlet works and extension of the existing outlet, an alteration of the downstream reach of the Almaden Calero Canal, the relocation of McKean Road and the development of a park facility around the reservoir.

The following criteria was established:

Hydrology

Drainage area - 6.9 square miles
Average annual runoff - Calero Drainage 2340 A.F.
Average annual diversion from Almaden Reservoir - 10,930 A.F.
100 year flood peak (Inflow) - 2710 cfs.
Maximum probable flood - 8690 cfs. (12 hour storm).

Dam and Reservoir

Type of Construction - earthfill section with inclined drain on the downstream face. Enlargement of main dam is on the downstream face (random fill with impervious cutoff) and for auxiliary dam the impervious fill is on the upstream face and the random fill is on the downstream face.

Top of Dam elevation - 520 feet (existing 490 feet)
Dam Height - 120 feet (existing 90 feet)
Crest length - 1050 feet
Crest Width - 20'
Side Slopes - Main dam 3:1
Auxiliary dam upstream face 3:1, downstream face 2½:1

Reservoir Capacity -
Total Capacity 24,000 A.F. (W.S. elev. 513 feet)-existing storage capacity - 10,750 A.F.
Active Capacity 23,000 A.F. (W.S. elev. 512 feet)-existing storage capacity - 10,750 A.F.
Normal Min Pool 6,000 A.F. (W.S. elev. 470 feet)

Reservoir Area at Maximum Storage 593 acres (existing 358 acres)

Outlet Works - Existing - gated 36 inch conduit
Proposed - gated intake tower with 96 inch conduit.

Almaden-Calero Canal Extension - 66 inch pipe and siphon .
Capacity - 120 cfs.

Spillway - Concrete lined ogee spillway at the location of the existing facility and tied to the existing chute.

Capacity - 2000 cfs
Crest length - 55 feet

Fill Quantity - Main Dam 1,444,000 Cubic Yards.

Auxiliary Dam

Crest Elevation - 520 feet
Crest Width - 20 feet
Crest Length - 2200 feet (existing 1600 feet)

Land Requirement

Reservoir Project - 494 acres
Total - 971 acres
Existing - 493 acres

The Calero Recreation area includes facilities for camping, picknicking, boating, swimming and fishing. These facilities include roads, parking area, boat ramps, fishing piers and a water supply and sanitary system. The following criteria was established:

Annual Visitation - 1,091,000 people
Picnic Units - 467
Camping Units - 140
Area - 176 acres
Boat Ramps - 4
Fishing Piers - 5
Comfort Stations - 24

The geologic and engineering feasibility investigation (stage 1) defined the geologic character of the area and engineering feasibility of raising Calero Dam. A major portion of the work was directed to defining the geologic character and engineering stability of the right abutment ridge of the main dam. This also included a preliminary dam modification design. This study concluded that geologic conditions are acceptable, seismic potential is moderate, the main and auxiliary dams can be raised economically, an impervious blanket is required at the right abutment, a buttress berm should be considered to increase the stability of the right abutment knob and the spillway can be raised at the present location.

The multipurpose project costs, construction and O.M.&R., based on 1970 prices are summarized below:

Construction Costs	
Reservoir Project	$6,321,000
Land Acquisition	4,746,000
Recreation Facilities	3,617,000
Water Supply and Sanitary Facilities	2,229,000
Sub Total	$16,913,000
O.M.&R. Costs	
Reservoir Project	342,000
Recreation Facilities	4,387,000
Replacement Facilities	3,225,000
Sub Total	$7,954,000
Total	$24,867,000

Net economic benefits for each of the purposes are summarized below:

Purpose	Benefits
Water Supply	$ 4,411,000
Recreation	18,338,000
Fish Enhancement	4,392,000

The project costs were allocated to the separate purposes based on the Separable Costs Remaining Benefits method. The cost allocated to water supply was $3,932,000 (15.8%) to recreation was $17,208,000 (69.2%) and to fish enhancement was $2,546,000 (15.0%). The benefit/cost ratio for the multipurpose project was 1.09.

Financing: In an agreement between the District and the County, the District will be responsible for the construction costs allocated to water supply and the related O.M.&R. costs and the County will be responsible for the construction costs allocated to fish enhancement and recreation and related O.M.&R. costs. A portion of the construction costs allocated to recreation and fish enhancement may be financed through State assistance in the form of grants made possible under the Davis-Grunsky Act. The requested grant for recreation is $5,534,000 and for fish enhancement is $1,265,000. In addition, a grant to construct water supply and sanitary facilities is available and the requested amount was $1,700,000. Considering these grants, the construction costs to be financed by the District are $2,278,000 and by the County are $6,135,000. Considering O.M.&R. costs, the total annual cost to the District is $167,000 and to the County is $872,000.

Conclusions: The multipurpose project as amended is economically feasible and should be constructed. Construction of the Reservoir Project should be completed by 1975 along with the East Side Recreation area. The remaining recreation areas would be completed by 1982, a 10-year development period. Considering a grant from the State in the amount of $6,800,000 adequate resources are available to construct and operate the facilities.

ENLARGEMENT OF CHESBRO DAM AND RESERVOIR

This is one of the proposed flood control features of the "Llagas Creek Watershed" project prepared by the Loma Prieta Soil Conservation District, Santa Clara County Flood Control and Water District and South Santa Clara Valley Water Conservation District. The engineering and geologic investigations were preliminary in scope. The purpose of this project is to provide additional storage in Chesbro Reservoir for flood control on Llagas Creek.

The existing dam is located on Llagas Creek about 2000 feet upstream from Llagas Avenue.

The project consists of the raising of existing Chesbro Dam by 11 feet, a modification to the existing spillway and an extension of the existing outlet works.

Hydrology:

a. Drainage area - 18.9 square miles
b. Maximum storm inflow - 20,350 cfs. (1% return period)
c. Maximum outflow - 11,000 cfs.

Dam and Reservoir Design Criteria:

a. Type of fill - Raise existing Chesbro Dam 11 feet with an homogenous earth fill on the downstream face.
b. Height of dam (enlarged) 116 feet (height of existing dam 105 feet)
c. Spillway - Concrete Ogee Crest - 80 feet wide with a 25 foot by 12 foot deep notch to serve as principal spillway. Combined spillway capacity is 11,000 cfs.
d. Principal elevations:
    1. Stream bed - 430 feet
    2. Top of sediment pool - 464.5 feet
    3. Top of conservation pool - 525 feet. (top of primary spillway crest)
    4. Top of flood retention storage 537 feet (top of emergency spillway crest)
    5. Top of dam - 546 feet.
e. Reservoir storage:
    1. Sediment pool - 110 acre feet
    2. Conservation pool - 7520 acre feet
    3. Flood detention - 3570 acre feet
    Total - 11,200 acre feet
f. Surface area
    1. Conservation pool - 275 acres
    2. Flood detention - 327 acres

The geologic investigation indicated that the right abutment is founded on sheered sediments of the Franciscan formation. The left abutment is composed of serpentine. These rocks were found to be adequate to support the 11 foot surcharge. Materials for construction can be obtained from the reservoir floor.

The operation of Chesbro Reservoir for conservation will not be changed and the combination spillway will regulate storage in the flood control pool. Operation and maintenance of the facilities will be done by the South Santa Clara Valley Water Conservation District.

The estimated construction costs, based on 1960 prices, are $1,092,500 for construction and $20,000 for geologic exploration. Of this total amount the Soil Conservation Service will fund $535,100 and $577,400 must be provided from other sources. Estimated annual operation and maintenance cost is $2,300. The total capital cost, based on 1970 prices is $1,900,000 for the dam and Reservoir, plus the $20,000 for geologic exploration.

Recommendations: The overall flood protection benefits exceed the overall cost, of which Chesbro Reservoir is a part, by a ratio 2.1 to 1.0; therefore, this overall project is feasible.

Comments: This project to raise Chesbro Dam only considered flood control. Based on historical runoff, it appears that an additional increment of water conservation should be considered along with recreation and the costs allocated to the 3 purposes. An exploratory study to determine the optimal capacity for conservation was completed by the District in February 1970, and it was concluded that the costs exceed the benefits. A more detailed operation study of this facility may show that raising the dam for additional conservation is economic and feasible.

ENLARGEMENT OF CHESBRO DAM AND RESERVOIR

In 1967 the Llagas Creek Watershed report prepared jointly by the Loma Prieta Soil Conservation District, the Santa Clara County Flood Control and Water District and South Santa Clara Valley Water Conservation District in 1962 was revised. This revision divided the Llagas Creek Watershed project into 2 areas, the upper and lower watersheds, and separate reports with updated costs were prepared. The criteria for raising and operating Chesbro Dam is exactly the same as that shown in the single project report.

The estimated construction cost based on 1967 prices for raising Chesbro Dam and enlarging the outlet works is $1,153,400. Of this amount $582,200 will be met from Public Law 566 funds and $570,700 must be provided from other sources.

Recommendations: The overall project is feasible and the raising of Chesbro Dam should be included in the upper Llagas Creek Watershed Project.

Comments: Same comments as shown for 1962 report.

ENLARGEMENT OF EXISTING CHESBRO DAM AND RESERVOIR

The name of this project is "Chesbro Reservoir Study - Reservoir Enlargement and Operation". The study was done by the Santa Clara County Flood Control and Water District in February 1970. The study was exploratory in scope and the purpose was to determine the optimal capacity of a single purpose reservoir at the existing site for water conservation.

This study did not include a geologic investigation and no attempt was made to establish structure details.

A cost model was developed to determine the optimum capacity of a single purpose reservoir based on a simplified hydrology and operation procedure, i.e., water is stored during the wet season and released in the dry season at constant rates, at the end of each water year the reservoir is empty, demands are unlimited and minor losses are ignored.

The average annual flow based on 50 years of recorded data was estimated to be 8,860 acre-feet. Flood flows were not considered.

Unit cost of water vs. optimal reservoir storage curves based on the average annual inflow of 8,860 acre-feet indicate that the optimal conservation capacity exceeds the present capacity only if the unit cost of water is more than $37/acre-feet for an interest rate of 5% and $70/acre-feet for an interest rate of 10%.

Conclusions: It appears that increasing the conservation capacity of the existing reservoir to above the present capacity is not economically justified when a single purpose project is considered.

For comparison, a simulation procedure was used (C of E Computer Program "Reservoir Yield") to establish the water conserved in hypothetical reservoirs larger in storage capacity than the existing facility. The present worth of water saved when compared to the additional construction cost to raise the dam indicates that it is not economic to consider additional conservation storage for a unit price of water below about $50/acre-feet (5% interest rates). This confirms the conclusions reached utilizing the optimal cost model.

Comments: The results of this study can only be considered as an indication of unit water costs due to the over simplification of the hydrology and operation of the reservoir. A more detailed operation study considering flood control and recreation as well as conservation could result in an economically feasible project based on properly allocated costs.

COAST STREAM WATER SUPPLY FOR PALO ALTO

The name of this study was "An Investigation of Coast Stream drainage Areas for Possible Water Supply Sources for the City of Palo Alto". This was a thesis for the degree of Engineer (Stanford University) and the work was done by Charles Hopkins Dodge and M. J. Van Lobin Sek in 1936. The purpose of this investigation was to establish the engineering and economic feasibility of developing water supplies on Coast Streams in Santa Cruz County for diversion to Palo Alto as a domestic water supply.

Reservoir sites were considered on the Pascadero, Mindego and La Honda drainages. The site on Pascadero Creek was located 2½ miles above the old dam site considered by the Spring Valley Water Company at stream bed elevation 180. The Mandego-Alpine dam site was located one mile below the junction of these two creeks and Mandego-Alpine-La Honda site was located just down stream from the junction with La Honda Creek.

The geologic investigation was limited to a preliminary aerial survey of the areas. The rock formations are mainly Monterey Sandstones and shales with areas of diabese and basalt. Two fault zones are in the area: 1) the San Gregorio, and 2) the San Andreas.

The following projects were considered:

1) The Poscadero Project - This project includes a dam and reservoir on Poscadero Creek, a pump station and diversion pipeline to Castle Rock ridge, a holding reservoir on Corte Madera Creek and a water treatment plant.

Hydrology:

a) drainage area - 38 square miles

b) safe yield - 5800 AF.

Dam & Reservoir

a) Type of dam - earthfill with rock facing

b) Crest length - 400 feet

c) Reservoir capacity - 4000 AF.

d) Fill quantity - 200,000 CY.

e) Stream bed elevation - 180 feet

f) Land required - 210 Ac.

g) Dam height - 65 feet.

h) Maximum water surface elev. - 235 ft.

The first cost based on 1936 prices was estimated to be $1,896,000 and O. M. & R. Costs were assumed to be $55,000 per year. Cost of water based on financing a $2,000,000 bond issue at 2% interest was set at 13.9 cents per 1000 gal. in 1938 and 11.5 cents per 1000 gal. in 1942. This first cost based on 1970 prices is estimated to be about $3,700,000.

This project was considered feasible and would be able to meet the future water needs of Palo Alto.

2) The Mindego-Alpine Creek Project - This project consists of one earth dam on Alpine Creek, a pump station and a diversion pipeline, regulating reservoir on Corte Madera Creek and Water Treatment Plant.

Hydrology:

a) Drainage area - 8 square miles

b) Safe yield - 2100 AF.

Dam & Reservoir

a) Type of Dam - earth fill with rock facing

b) Stream bed elevation - 515 feet

c) Reservoir Storage Capacity

Storage Reservoir - 5000 AF
Corte Madera Reservoir - 2100 AF

The yield from this project is not adequate to meet future water demands in Palo Alto and was not recommended.

3) Mindego-Alpine and La Honda Project. This project consists of a dam and reservoir on La Honda Creek, a pump station and diversion pipeline, and a water treatment plant, and regulating reservoir on Corte Madera Creek.

Hydrology:

a) Drainage Area - 18.2 square miles

b) Average Rainfall - 37 inches

c) Safe Yield - 4930 AF.

Dam & Reservoir

a) Type of Dam - Earthfill with rock facing

b) Reservoir Storage Capacity

Storage Facility - 5000 AF.
Regulating Reservoir - 4930 AF.

The yield from this project is adequate to meet the water supply needs of Palo Alto.

The following alternative sites were considered:

1) Dam and reservoir on Sousal Creek - This project consists of two diversion dams on La Honda Creek, a diversion pipe and tunnel to Sousal Creek and a dam site on Sousal Creek at stream bed elevation 500 ft.

   a) Drainage Area - 7 Square Miles

   b) Storage Capacity - 5000 AF.

   c) Yield from diversion dams on La Honda Cr. - 550 mg/yr.

The yield from this facility is too low and was not considered as an acceptable alternative.

2) Dam and Reservoir in La Honda Canyon and Alpine Canyon - The project consists of two earthfill dams and diversion facilities to Santa Clara County (pipeline, pump station and tunnel) and a treatment plant.

	La Honda Canyon Site	Alpine Canyon Site
Dam Height	150	70'
Reservoir Capacity	5000 AF	1600 AF
Crest Elevation	500 Ft.	515
Fill Quantity	500,000 CY.	-

The distribution system consists of 31,000 ft. of 16" pipe, two pump stations and an 830 foot tunnel.

3) Matadero Creek Dam & Reservoir - This project consists of an earthfill dam and 11,000 AF reservoir on Matadero Creek.

    a) Height of Dam - 125 feet

    b) Water Surface Elevation - 160 feet

    c) Fill Quantity - 500,000 CY.

4) Corte de Madera Reservoir - This project consists of an earthfill dam on El Corte De Madera Creek at stream bed elevation of 700 feet.

    a) Drainage Area - 3.5 square miles

    b) Storage Capacity - 1250 AF

    c) Height of Dam - 85 feet

These alternative projects were not considered to be economic alternatives and in most cases did not develop adequate water supplies to meet projected demands.

Comments: Storage facilities on Poscadero and La Honda Creeks appear to be economic alternatives for developing a domestic water supply for Palo Alto. These storage sites and division facilities should be studied in greater detail as alternatives to ground water pumping and the purchase of Hetch-Hetchy water.

DAM AND RESERVOIR SITES ON COYOTE CREEK

The name of this study is "A Report Upon the Utilization of the Water Supply of Coyote Creek". The study was done by Mr. Guido Galli as a thesis requirement for an advanced degree in 1931. The study was preliminary in scope. The purpose was to establish the engineering and economic feasibility of constructing storage facilities on Coyote Creek. The purpose for providing the storage and the water use were not discussed.

This study considered 2 dam sites. One located at the upper gorge of Coyote Creek where the creek leaves the hills and enters the valley and a second site located about 5 miles upstream from the lower site on Coyote Creek.

Each project consists of a earthfill dam, concrete lined spillway and gated outlet works.

Hydrology:

a) Average annual draft 20,000 AF (120,000 AF of storage)

b) Average annual draft 14,000 AF (60,000 AF of storage)

Dam and Reservoir Design Criteria:

	Site 1 (downstream)	Site 2 (upstream)
Type of Dam	earthfill	earthfill
Height of dam	210	150 feet
Crest Length	1085 feet	1020 feet
Storage Capacity	60,000 AF	60,000 AF
Max. water surface area	900 AC	950 AC
Max. Water surface elev.	605 feet	790 feet
Fill quantity	1,878,450 CY	537,170 CY

Costs:

	Site 1			
	1931 prices	1970 prices	1931 prices	1970 prices
First Cost	$ 2,741,600	$5,500,000	$ 1,080,310	2,160,000
Cost/Acre of Reservoir	$ 192/AC	-	$ 105/AC	-
Annual Cost per Acre of Reservoir	$15.95/AC	-	$ 8.30/AC	-

Conclusions: These projects were considered to be feasible and should be constructed when the need and method of financing is established. It appears that the cost at this time is too great for agricultural use.

Remarks: In the study no attempt was made to assign a purpose to the project and allocate costs.

DAM AND RESERVOIR SITE ON COYOTE CREEK

The name of this project is "Damsites on the upper Coyote Creek". The study was done by the Santa Clara County Flood Control and Water District with a first draft submitted in April 1970. The study was exploratory in scope and considered 3 possible dam sites on upper Coyote Creek for storing water. No attempt was made to assign purposes; compute benefits and allocate costs.

The 3 sites considered were all located on the main branch of Coyote Creek upstream from existing Coyote Reservoir. Dam Site No. 1 was located about 1500' downstream from the confluence with Los Osos Creek, Site No. 2 was about 2000 feet upstream from this confluence and Site No. 3 was about 4500 feet upstream from the Los Osos Creek confluence.

The Main dam was a zoned rock earth embankment structure with concrete lined chute spillway and gated outlet works. In addition to the main dam at Site No. 1 a check dam and pumping plant was considered on Los Osos Creek to minimize the inundation of about 500 acres in Los Osos Canyon. Two sites were considered for this check dam, one 6500 feet and a second 1200 feet from the confluence with Coyote Creek. A third site was studied but not considered.

Hydrology:

Main Dam

a. Drainage area

Site 1	105.2 square miles (Los Osos Canyon at Confluence 10.6 square miles)
Site 2	94 square miles
Site 3	83 square miles

b. Mean Annual Runoff

Site 1	27,500 acre feet
Site 2	24,500 acre feet
Site 3	22,000 acre feet

c. Maximum Discharge

Site 1	24,300 cfs (1% peak flow), 30,900 A.F. (48-hour 1% volume)
Site 2	22,000 cfs (1% peak flow), 28,500 A.F. (48-hour 1% volume)
Site 3	19,000 cfs (1% peak flow)

Check Dam - Site 1

Drainage area Site A-6.6 square miles. Site C-10.4 square miles. Maximum discharge (1% Flood). Site A-1800 cfs. Site C-2850 cfs.

Dam and Reservoir Design Criteria:

Main Dam and Check Dam (Site 1)

a. Type of dam - Zoned rock and earth fill embankment.
b. Height of dam
Site 1 - 190 feet (crest elevation 1010 feet)
Site 2 - 175 feet (crest elevation 1010 feet)
Site 3 - 165 feet (crest elevation 1010 feet)
Check Dam, Site A - 60 feet, Site C - 150 feet

Crest Length

Site 1 - 910 feet
Site 2 -1350 feet
Site 3 - 940 feet
Check Dam, Site A - 1060 feet, Site C - 810 feet

Reservoir Capacity

Site 1 - 74,350 Ac.Ft. at Water Surface El. 1000 feet
Site 3 - 37,250 Ac. Ft. at Water Surface El. 1000 feet

Check Dams for Site 1 - additional design criteria

Site	Pump Disch.		H.P.	Inundation (upstream) Acres	Max. Pool Elev.	Storage Lost in Main Res. Ac. Ft.
	50% Flood	20% Flood				
A	365		3900	1800	985	3147
		670	7200	1200	975	
C	465		11,000	2500	935	16,807
		870	20,500	1700	925	

The geologic investigation was exploratory in scope. The site is on a massive sandstone-shale formation and is acceptable for this type of structure.

No attempt was made to operate the reservoirs for a purpose, (i.e., flood control). The check dams in Study No. 1 were constructed to limit the inundation in Los Osos Canyon and any inundation upstream of the check dams is pumped out as rapidly as possible.

The total costs for each alternative based on 1970 prices are summarized below.

	Site 1	Site 2	Site 3
Main Dam & Res.	$10,000,000	$10,000,000	$7,000,000
Cost/Ac.Ft.	$140.00	$270.00	$530.00
Cost of Main Dam & Res. with Check Dam A	$9,700,000		
Cost of Main Dam & Res. with Check Dam C	$9,700,000		
Cost of Check Dam A	$3,000,000		
Cost of Check Dam C	$6,600,000		

Conclusions: Physical properties of these sites may limit or preclude certain uses, for example, limited access and steep side slopes could restrict recreation development. Considering the existing storage on Coyote Creek it was proposed that the 3 reservoirs be operated to maintain the present conservation benefits and increase flood control and recreation benefits. The development of operation criteria and the allocation of costs to the separate purposes should be included in a more detailed feasibility report.

Comments: It appears that this is an exploratory study to determine a rough cost for developing additional storage on Coyote Creek. This study should be expanded to include the operation of the 3 reservoir systems for flood control, water conservation and recreation. Based on the alternatives considered, benefits should be established and costs allocated.

DAM AND RESERVOIR ON GUADALUPE CREEK

The name of this project is "New Guadalupe Dam and Reservoir". This study was done by the Santa Clara County Flood Control and Water District in 1968. A revision to this study was completed in May 1970. The engineering and geologic investigation was preliminary in scope. The purpose was to investigate the economics of constructing a second dam on Guadalupe Creek for water conservation, flood control and some measure of recreation. The development of hydro power was not considered.

The dam site is located on the main branch of Guadalupe Creek at Hicks Road downstream from the existing dam.

The project consists of an earthfill dam with a rock facing, concrete lined ogee crest spillway, gated outlet works and the relocation of Hicks Road.

Operation Criteria - 1968 Study

The objective of this study was to provide an optional measure of water conservation and flow regulation, together with flood control and a minimal provision for recreation. Therefore, water conservation was considered to be the primary purpose and flood control was introduced as a requirement for additional storage. A minimum pool was adopted for recreation but this purpose was not considered in the operation of the reservoir.

The combined operation of the existing and proposed reservoirs was considered and the optimum storage for conservation in the new reservoir was established based on operation-simulation computer runs using the Corps of Engineer's program "Reservoir Systems Analysis Conservation for 25 years of routing with 3 control points. The releases for water supply were assumed to be constant at 13 cfs (close to the average natural yield of the stream which is 12 cfs) with no seasonal variation. Computer runs based on conservation pools ranging from 12,080 AF to 32,000 AF indicated that the optimal storage capacity was 23,000 AF. Considering other economic factors a slightly smaller water conservation pool of 19,300 AF was suggested.

Provisions for flood control were included as a minimum storage above the conservation pool need to control the 100 year flood. Releases from the new dam combined with the natural runoff to the confluence with Alamitos Creek were limited to not more than 1600 cfs. Two alternatives were considered 1) Store the 34 hour-100 year flood volume estimated to be 7000 AF and 2) store the same flood volume as in alternative 1 to limit the downstream flow to 1600 cfs. - estimated volume 3000 AF.

Recreation was not considered in the operation criteria but a minimum pool of 2000 AF was adopted for this purpose and for silt storage.

Hydrology

a. Level of flood protection - 100 year flood (34 hour volume = 7000 AF and peak inflow = 12,680 cfs)

b. Maximum probable flood - outflow
   with 3000 AF of flood control storage 9,350 cfs
   with 7000 AF of flood control storage 1,500 cfs

c. Storage requirement to limit 100 year downstream flood flows to 1600 cfs is about 3000 AF

d. Annual yield (19,300 AF of storage) is 9040 AF

Dam and Reservoir Design Criteria:

1. Type of Dam - Zoned earth embankment with 3 to 1 side slopes. (Impervious core with rock fill).

2. Reservoir capacity - 24,300 AF (19,300 AF for conservation 3000 AF for flood control and 2000 AF as minimum pool).

3. Outlet works capacity 1600 cfs at minimum pool elevation (66" diameter pipe).

4. Spillway size and capacity

   a. 200 feet long with a capacity of 9350 cfs at a head of 5.6 feet (3000 AF storage for flood control)

   b. 40 feet long with a capacity of 1500 cfs at a head of 4.75 feet (7000 AF storage for flood control).

5. Height of dam above stream bed - 199 feet (Elevation 524.5 feet).

6. Top of flood control pool - 524.5 feet.

7. Fill quantity - 7,100,000 cubic yards.

Capital costs for the dam and reservoir (without appurtenances) were computed based on 3 alternative water conservation pools and 2 flood control pools. These costs were for comparative purposes and are summarized below based on 1968 prices.

Storage Capacity (Total) AF	Capacity for Water Cons. AF	Capacity for Flood Control AF	Total Cost $\$ \times 10^6$	Allocated Cost Rec. $\$ \times 10^6$	Allocated Cost Water $\$ \times 10^6$	Allocated Cost F.C. $\$ \times 10^6$
31,000	22,100	7000	14.1	.9	11.4	2.1
28,300	19,300	7000	13.1	.9	10.1	2.1
21,080	12,080	7000	10.2	.8	7.5	1.9
27,100	22,100	3000	12.6	.8	11.4	.4
24,800	19,300	3000	11.4	.8	10.1	.5
17,080	12,080	3000	9.8	.8	7.5	1.5

Note recreation pool is 2000 AF

Total costs for 3 alternative reservoirs with 3000 AF for flood control are summarized below:

Reservoir Capacity AF	Dam & Res. $\$ \times 10^6$	Spillway & Outlet $\$ \times 10^6$	Total Cost $\$ \times 10^6$	Allocated Cost Res. $\$ \times 10^6$	Allocated Cost Water $\$ \times 10^6$	Allocated Cost F.C. $\$ \times 10^6$
17080	9.8	0.7	10.5	0.9	8.0	1.6
24300	11.4	0.8	12.2	0.9	10.8	.5
27100	12.6	0.9	13.5	0.9	12.2	.4

Annual costs are \$456,000 (17,080 AF storage), \$615,000 (24,300 AF storage) and \$695,000 (27,100 AF storage) and the costs per acre foot are \$53.10, \$68.00 and \$76.50 respectively.

May 1970 Restudy of the Proposed Reservoir

In the May 1970 revision the effects of 1) the enlarged Calero Reservoir, 2) the proposed Almaden-Calero Reservoir operation and 3) the proposed new dam on Guadalupe Creek were considered in a restudy of the hydrology and operation of the Guadalupe River system. The new Guadalupe River Reservoir was considered as a 1) multipurpose reservoir for flood control, water supply and recreation, 2) as a flood control and recreation facility and 3) as a single purpose flood control facility.

Changes in the downstream flood control flows caused by the operation of the Almaden and Calero Reservoirs appear to be very small and it was assumed that the 1968 hydrology and operating criteria for the proposed Guadalupe Reservoir was reasonable.

Costs based on 1970prices for the single purpose reservoir and 2 multipurpose reservoirs are summarized below. The water conservation storage pool was set at 19,300 AF and 3000 AF was assigned to flood control (minimum pool 2000 AF).

		Allocated Cost			Annual Costs		
Project	Total Cost $\$x10^{6}$	Res. $\$x10^{6}$	Water $\$/10^{6}$	F.C. $\$/10^{6}$	5% int. $\$/10^{3}$	6% int. $\$/10^{3}$	8% int. $\$/10^{3}$
Multipurpose Proj. (3 pur.)	13.7	1.5	10.2	2.0	840	951	1,184
Multipurpose Proj. (2 pur.)	4.3	-	1.7	2.6			
Single Pur. Project	3.2			3.2			

For the multipurpose project the cost of water conserved ranges from \$69/AF to \$97/AF.

Conclusions: The cost per acre foot for conserved water delivered from the new Guadalupe Reservoir could not compete with the cost of imported water (\$68/AF vs. \$37.40/AF for imported water) and the average annual yield falls somewhat short of the proposed objectives. Since it was difficult to determine flood control benefits, it was felt that the cost of a single purpose flood control facility should be compared with the cost of downstream improvements. The cost of downstream improvements was estimated to be \$1,900,000 which is much lower than the single purpose cost of \$3,200,000 or the multipurpose allocated cost of \$2,550,000.

The operation of Calero and Almaden Reservoirs as proposed in the Calero Reservoir Report of 1967 has little affect on downstream flood peaks and any changes would result from the enlargement of Calero Reservoir.

Comments: It appears that this second reservoir on Guadalupe Creek is not economically justified. It is cheaper to purchase imported water and construct channel improvements downstream. Based on these large cost differences, it may be difficult to justify the water supply and flood control purposes by refining the cost allocation.

DAM AND RESERVOIR SITE ON GUADALUPE CREEK

The name of this project is "Second Dam and Reservoir on Guadalupe Creek". The engineering feasibility study was made by the former Santa Clara Valley Water Conservation District and the work was completed in 1956. The engineering and geologic analysis was preliminary in scope. The purpose of the investigation was to establish the engineering and economic feasibility of constructing a second dam and reservoir on Guadalupe Creek for the conservation of local runoff for ground water recharge and flood control.

This project is located on Guadalupe Creek near the mouth of Guadalupe Canyon about 3/4 miles downstream from Shannon Road. The drainage below the existing dam is 7.44 square miles and the total drainage area is 13.44 square miles.

The project consists of an earth filled dam on Guadalupe Creek and includes a concrete lined chute type spillway, gated outlet works and diversion structures for offstream percolation facilities to be constructed in the area along Guadalupe Creek between the hills and Los Alamitos Creek.

Dam and Reservoir Design Criteria:

1. Type of dam - earth filled with rock facing.
2. Height of dam above stream bed - 110 feet
3. Crest length of dam - 2375 feet (Elevation 395 feet).
4. Fill Quantity - 1,500,000 Cubic Yards
5. Spillway design capacity - 10,000 cfs.
6. Maximum water surface elevation - 380 feet (freeboard 15 feet).
7. Reservoir Capacity - 5500 Acre Feet.

The geologic investigation was preliminary and it was determined that two faults and sheared rock zones underlie portions of the reservoir. Leakage through the bottom of the reservoir into the old Guadalupe mines could be a problem. In addition, a large amount of stripping is required to expose acceptable foundation material and construction materials are available at the site.

Local runoff that is not stored in the existing Guadalupe Reservoir and runoff originating below the existing dam is stored in the lower reservoir and released into the main creek bed for ground water recharge. This flow is diverted downstream to offstream percolation ponds. By providing a storage reservation in both reservoirs during the flood season (no valves shown), a large measure of flood protection to the North San Jose area could be provided. No estimate of the benefits was made and no criteria for flood control was given.

The estimated total construction cost based on 1955 prices was estimated to be $2,524,000. Based on the ENR cost index the estimated present cost (1970 prices) is about $4,600,000. The cost per acre foot based on local financing (1955 costs) was estimated to be $21 and with Federal assistance was about $17.

Recommendations: The project was considered feasible and recommended for construction as a flood control and conservation facility.

Comments: Recreation has not been considered as a purpose, and no attempt was made to establish benefits and allocate costs to the separate purposes. Considering the potential recreation and flood control benefits associated with this project, it appears that this project should be looked at in greater detail.

DAM AND RESERVOIR SITE ON LITTLE ARTHUR CREEK

This dam and reservoir site was one of the alternatives considered by the Corps of Engineers in their Pajaro River Basin Study. The engineering and geologic investigation was exploratory and the purpose was to establish the engineering and economic feasibility of constructing a dam and reservoir on Little Arthur Creek for flood control and water conservation.

The project consisted of an earthfill dam, concrete lined spillway and gated outlet works.

REMARKS: Additional information on hydrology, design criteria and costs was not found at the Corps of Engineers office in San Francisco.

The project was not found to be economically feasible and was eliminated from further consideration.

DAM AND RESERVOIR SITE ON MATADERO CREEK

The name of this project is "Impounding Reservoir on Matadero Creek". The study was made by Harry H. Jenks, Consulting Engineer for the Santa Clara County Flood Control and Water District and was completed in February 1957. The engineering and geologic investigation was preliminary in scope. The purpose was to establish the feasibility of constructing a reservoir on Matadero Creek for water conservation with flood control as a secondary purpose.

The dam was located on Matadero Creek about 1/2 mile west of Junipero Serra Boulevard.

The project consists of an earthfill dam, 25 foot high dike, concrete-lined spillway and gated outlet works. The reservoir occupies nearly all of the valley upstream from Junipero Serra Boulevard and about 1-1/2 miles of Page Mill Road must be relocated along with several driveways. In addition, a diversion canal is needed from the spillway to Matadero Creek.

Hydrology:

a. Drainage area - not known
b. Maximum safe yield - 240 acre-feet
c. Design flood - not computed
d. Active life of reservoir - 50 years

NOTE: Runoff for the period 1931 to 1941 and 1950 to 1954 was estimated based on a correlation study utilizing measured stream flow records on San Francisquito Creek and precipitation data measured at Palo Alto. This was checked by computing runoff based on the relationship Q = CiA.

Dam and Reservoir Design Criteria:

a. Type of dam - earthfill with rock facing.
b. Crest length - 800 feet (Elevation 260 feet).
c. Height of main dam - 125 feet
   Height of dike - 25 feet
d. Spillway (100-year frequency flood peak) - No discharge data given.
   Spillway crest elevation 280 feet. (Freeboard - 5 feet)
e. Reservoir capacity - 3,850 acre-feet with an active capacity of 2,500 acre-feet, a salt storage of 1,250 acre-feet and a flood control reservation of 100 acre-feet.
f. Surface area at maximum water surface - 220 acres.
g. Evaporation losses - 4 feet per year.

The geologic investigation was a preliminary aerial survey and the site was found acceptable for this size of dam. Construction materials are available at the site and seepage was not considered to be a problem. In addition, erosion in the higher elevations was found to be a problem and the salt load heavy at high flows. Assumption - reservoir would be filled with silt in 100 years.

The primary purpose of this reservoir is water conservation. By reserving 100 A.F. for flood control, the 100 year flood peak can be retained. This storage can be encroached upon for the period May 1 to September 1.

The transfer of water from Los Trancos Creek and Felt Lake through a diversion tunnel was considered as a supplemental source of supply. This was not found to be economically feasible.

The total construction cost based on 1956 prices is $2,672,000 which includes the purchase of 220 acres of land. This cost based on 1970 prices is estimated to be $4,800,000. Operation and maintenance costs were not computed.

Recommendations: It was recommended that the Matadero Creek Impounding Reservoir Project be abandoned based on economic considerations.

Comments: Based on the costs shown, it does not appear that this project could be made feasible even though separate purposes (flood control, conservation and recreation) were considered and cost allocated.

DAM AND RESERVOIR SITE ON PACHECO CREEK

The name of this project is "Pacheco Creek Dam Site". This was one of the alternative projects considered by the Corps of Engineers as a part of the larger Pajaro River Basin Study completed in 1965. The engineering and geologic investigation was limited to a reconnaissance type study. The purpose of the investigation was to establish the engineering and economic feasibility of constructing a multi-purpose dam and reservoir on Pacheco Creek for flood control, water conservation and recreation purposes.

The dam site was located on the main branch of Pacheco Creek about 6 miles northeast of Dunneville and 3.6 miles above the U.S. Geological Survey gaging station.

The project consisted of an earth fill dam, uncontrolled concrete lined spillway and gated outlet works. Also included was the relocation of Highway 152.

Hydrology:

Drainage area - 130 square miles
Average annual flow* - 19,000 acre feet
Average annual precipitation - 18 inches
Standard project flood* - 34,000 acre feet
Average annual yield*
    Alt. No. 1 (water cons. storage of 8,000 A.F.) - 5,000 A.F.
    Alt. No. 2 (water cons. storage of 23,000 A.F.) - 8,000 A.F.

* Adjusted for the operation of existing North Fork Reservoir

Alternative No. 2 assumes that the maximum physical storage capacity is developed (limited by the existing dam on the north fork of Pacheco Creek) and the additional capacity is allocated to water supply. Total reservoir capacity was 55,000 A.F.

Dam and Reservoir Design Criteria:

a. Reservoir Capacity

Alt. No. 1	Water Cons.	8,000 A.F.
	Flood Control	26,000 A.F.
	Min. Pool	6,000 A.F.
	Total Capacity	40,000 A.F.
Alt. No. 2	Water Cons.	23,000 A.F.
	Flood Control	26,000 A.F.
	Min. Pool	6,000 A.F.
	Total Capacity	55,000 A.F.

b. Information on size of dam, spillway and outlet works is not available.

The following annual benefits were established:

a. Flood Control - $53,000 - This was based on a reduction in the standard project flood for Pacheco Creek from 19,000 cfs. to 11,000 cfs at Highway 101.

b. Water Conservation-Alt. No. 1 - $100,000; Alt. No. 2 - $160,000. Alternative No. 1 was based on a storage allocation of 8,000 A.F. and Alternative No. 2 was based on the maximum storage allocation of 23,000 A.F. The cost of water was assumed equal to the value suggested by the U.S. Bureau of Reclamation for water delivered at the exit of the Pacheco Tunnel ($20 per acre foot).

c. Recreation - $80,000. Based on a limited recreation facility and a minimum pool of 6,000 A.F.

The following cost estimates were established:

First Cost

a. Dam and Reservoir (Alt. No. 1) $10,800,000 based on 1965 prices. This cost based on 1970 prices is about $15,100,000. Alt. No. 2 - no data.
b. Recreation Facilities - $46,000 based on 1965 prices. This cost is about $64,000 based on 1970 prices.

Annual Costs

a. Alt. No. 1. The total annual cost including O.M.&R. was estimated to be $410,000 based on an interest rate of 3-1/8%.
b. Alt. No. 2. The total annual cost including O.M.&R. was estimated to be $430,000 (includes 38,000 for O.M.&R.) based on an interest rate of 3 1/8%.

Benefit Cost Rate

a. Alt. No. 1 - 0.6
b. Alt. No. 2 - 0.7

No data was available on the cost allocation study.

Conclusions: The annual costs for this facility (both alternatives) exceed the benefits and the project was not considered to be economically feasible. To make this facility feasible (B/C ratio of 1.0), the price of water would have to be about $40 per acre foot. It may be possible to increase the benefits to water supply by considering this reservoir as a regulating or terminal facility for San Felipe Project water.

Remarks: It appears that additional water supply benefits could be assigned to this project by considering the reservoir as a regulating facility as mentioned above. However, based on the 1970 costs, it may be difficult to establish the benefits needed for a 1.0 benefit-cost ratio.

DAM AND RESERVOIR SITE ON PACHECO CREEK

The name of this project is "Harper Canyon Dam and Reservoir". The engineering study was done by the State Department of Water Resources as a part of the California Water Plan. The engineering and geologic investigation was preliminary in scope. The purpose of the investigation was to establish the engineering and economic feasibility of constructing a dam and reservoir on Pacheco Creek for the regulation of South Bay Aqueduct deliveries. This would also be a terminal facility for the Aqueduct. This project was abandoned when the terminus of the South Bay Aqueduct was moved from the Pajaro River to Los Coches Creek.

The project was located on the main branch of Pacheco Creek about 12 miles east of Gilroy, downstream of the confluence with the North branch of Pacheco Creek.

The project consists of an earthfill dam, ungated concrete lined spillway and gated inlet and outlet facility.

Hydrology:

No information available.

Dam and Res. Criteria:

Type of dam - earthfill with rock facing

Height of dam - 150 ft.

Normal pool elev. - 413 ft.

Storage capacity - 65,000 AF

Costs:

The total construction costs based on 1957 prices is about $7,560,000. (1970 costs are estimated to be about $13,600,000.)

Mr. Don Finlayson, State Department of Water Resources, was not able to locate any additional information on this project in the State files.

DAM AND RESERVOIR SITE ON PACHECO CREEK

This is a summary of the reservoir sites considered in the preliminary report to the Pacheco Pass Water District by T. H. Fowler in 1932. The engineering and geologic analysis was preliminary in scope. The purpose was to establish the engineering and economic feasibility of constructing a dam and reservoir on Pacheco Creek for ground water recharge. Flood control was mentioned but not considered as a purpose in the operation of the reservoir.

Two sites were investigated, one located on the main branch of Pacheco Creek below the north fork and the second located on the north fork of Pacheco Creek about one mile upstream of the State highway bridge.

The project consisted of concrete dam (buttress type) with concrete lined overflow spillway and gated outlet works .

The dam site on Pacheco Creek was abandoned in favor of the site on the north fork of Pacheco Creek and 3 alternatives were studied.

Hydrology:

a. Drainage area - 67.7 square miles

b. Average annual precipitation - 14 inches to a maximum of 20 inches to 25 inches.
Flood flows - Flows estimated for 30 years of record based on a correlation with Coyote Creek. Maximum estimated flood volume for the 1907-08 to 1930-31 period was 39,240 acre feet.

c. Average annual amount of water stored
Alt. No. 1 - 2615 acre feet
Alt. No. 2 - 3009 acre feet
Alt. No. 3 - 3484 acre feet

d. Average annual inflow - 10,255 acre feet

Dam and Reservoir Design Criteria:

a. Type of dam - Buttress type concrete dam with overflow section.

b. Reservoir capacity
Alt. No. 1 - 3425 acre feet (W.S. elevation 165 feet)
Alt. No. 2 - 4060 acre feet (W.S. elevation 170 feet)
Alt. No. 3 - 4825 acre feet (W.S. elevation 175 feet)

c. Top of dam elevation
Alt. No. 1 - 170 feet
Alt. No. 2 - 175 feet
Alt. No. 3 - 180 feet

d. Spillway capacity - 23,000 cfs.

Costs:

	1932 prices	1970 prices
Alt. No. 1	$156,150	$310,000
Alt. No. 2	174,690	350,000
Alt. No. 3	195,592	392,000

Geology:

The geologic investigation was preliminary. It was found that the foundation rock is sound and satisfactory for the type of dam proposed. Overburden at the dam site is shallow. Based on test pit inspections, it was found that the rock is crystalline, very hard, showing some seams and not greatly fractured.

Conclusions: A dam and reservoir on the north fork of Pacheco Creek is economically feasible and should be constructed. The reservoir should be operated for water conservation and the flood peaks controlled as much as possible.

Remarks: Based on this old study, a dam and reservoir was built on the north fork of Pacheco Creek. In this study no attempt was made to establish flood control criteria, provide a storage reservation for flood control and develop operational criteria for a multi-purpose facility.

DAM AND RESERVOIR SITE ON PASCADERO CREEK

The name of this study is "Investigation of Pascadero Creek as a Source of Water for Palo Alto, California". This is a thesis for the degree of Engineer, (Stanford University) done by David More in 1952. The study was preliminary in scope. The purpose of the investigation was to establish the engineering and economic feasibility of constructing a dam and reservoir on Pascadero Creek in Santa Cruz County and diverting water into Santa Clara County as a domestic water supply for the City of Palo Alto.

The dam and reservoir site was located on Pascadero Creek about 8.6 miles upstream from the outlet to the Pacific Ocean and about 1 mile easterly of Pascadero Creek Road near Jones Gulch. The diversion pipeline follows Jones and La Honda Creeks to the ridge and discharges into Corte de Madera Creek. The water treatment plant is located near Corte de Madera Creek.

The project consists of an earthfill dam, concrete lined chute type spillway, and gated outlet works on Pascadero Creek, a pump station and 8.9 miles of pressure pipeline to Castle Rock Ridge, a 20" diameter gravity flow pipeline to Corte de Madera Creek (6.8 miles). A 12 mgd water treatment plant is located near Corte de Madera Creek. Also considered was a holding reservoir near the treatment plant.

The geologic investigation was a preliminary aerial survey. The rock is sedimentary, hard and acceptable for this type of structure. Acceptable construction materials are at or near the site.

Hydrology:

a) Drainage area - 38.16 sq. mi.

b) Average annaul rainfall - 45.3"

c) Average annual runoff - 27,900 AF

d) Evaporation - 4.0 ft./yr.

e) Water demands - Palo Alto 7770 AF per yr.

f) Release for downstream water right - 2.5 cfs.

Dam and Reservoir design criteria:

a) Type of dam - rolled earth fill with rock facing

b) Height of dam - 108 ft. (Streambed elev. 180 ft)

c) Crest width - 20 ft., Crest length - 770 ft., Crest elev. - 288 ft.

d) Freeboard - 10 ft.

e) Side slopes - 3.1

f) Maximum water surface elev. - 278 ft.

g) Earth Quantity - 503,000 C.Y. fill

192,000 C.Y. stripping

h) Max. water surface area - 170 Ac.

i) Land required - 230 Ac.

j) Reservoir storage capacity - 8400 AF

k) Pump Station

Q=6980 gpm

l) Pipeline - 47,000 ft. of 18 inch pressure pipe and 36,000 ft. of 20 inch gravity pipeline

m) Distribution reservoir - 2.5 mg. tank

n) Water treatment plant - 12 mgd plant

Costs:

Item	1952 Prices	1970 Prices
Dam & Res.	$815,700	
Pipe	766,300	
Pump Station	259,000	
Water Treatment Plant	580,000	
District Res.	150,000	
Cont. & Eng.	681,000	
Subtotal	$3,292,000	

Item	1952 Prices	1970 Prices
Land	$ 149,500	
Easements for pipeline	49,800	
Interest	69,000	
Total Project	$3,520,300	$6,500,000
Annual Cost (2% Interest)	306,650	
Water Demand	1400 mg.	
Cost per mg.	$219	

An alternative to this proposed project considered the construction of a tunnel at Castle Rock Ridge. Tunnel length was 6200 feet at elevation 1035 ft. This alternative also considered a 1310 AF storage reservoir on Corte de Madera Creek for regulation. This proposal was abandoned, based on preliminary costs (values not shown).

Comments: It was considered feasible to construct a dam and reservoir on Pascadero Creek and pump this water over the Castle Rock Ridge into Santa Clara County as a domestic water supply for Palo Alto.

Remarks: The $219 per mg. (about $68 per A.F.) cost for water is based on a single purpose water supply project. This cost could possibly have been lowered by considering flood control and recreation and the allocation of costs to these purposes. Based on the estimated diversion of 1400 mg. and the estimated 1970 construction costs, it does not appear that this is an economic project. In addition, Palo Alto has designed their distribution system to accept Hetch Hetchy water.

DAM AND RESERVOIR SITE ON PENITENCIA CREEK

The title of this report is "A Study of Feasibility of a Dam Site on Penitencia Creek". The study was done by Mr. John Carson, Santa Clara University in 1964. The engineering and geologic analysis was very preliminary in scope. The purpose was to study the engineering and economic feasibility of constructing a dam and reservoir on the South fork of Penitencia Creek for water conservation and flood control.

The study looked at 3 alternative dam sites located on the south branch of Penitencia Creek in the vicinity of one mile upstream from the falls.

The project consisted of a conventional earth-rock fill dam, concrete lined spillway and gated outlet works.

Hydrology:

a. Watershed area
Dam Site No. 1 - 12.3 square miles
Dam Site No. 2 - 12.6 square miles
Dam Site No. 3 - 13.0 square miles

b. Average annual yield (No flood control reservation)
2635 acre feet (res. capacity - 4,500 acre feet)

c. Average annual yield with 1,500 acre foot reservation for flood control is 2100 acre feet (4,500 acre feet reservoir).

d. Average annual yield with a 1,000 acre foot reservation for flood control in 2,300 acre feet (4,500 acre feet reservoir).

Runoff at the site was estimated by multiplying the runoff at the U.S.G.S. gage (drainage area 22.26 square miles) by the ratio of drainage areas. No attempt was made to establish a flood runoff hydrograph.

A comparison of costs for reservoirs of different capacities at sites 1 and 3 indicated that site 1 should be considered. Site No. 2 was dropped without computing costs. This comparison study is shown below.

Site	Res. Capacity	Avg. Ann. Yield	Total Cost X 1,000	Cost/A.F.
1 (upstream site)	4,000 a.f.	3,736 a.f.	$1,064	$42.00
1 (upstream site)	2,000 a.f.	3,552 a.f.	$ 720	$32.30
3 (downstream site)	6,000 a.f.	4,348 a.f.	$2,300	$64.30
3 (downstream site)	2,000 a.f.	----------	$1,200	$32.30

Dam and Reservoir Design Criteria for the Upstream Site (Site No. 1).

	Large Dam	Small Dam
Type of Dam	Earth & rock fill	Earth & rock fill
Reservoir Capacity	4,000 A.F.	2,000 A.F.
Crest Length	580 feet	390 feet
Dam Height	186 feet	103 feet
Fill Quantity	870,000 cubic yards	197,975 cubic yards
Elev. top of dam	1,280	1,200

The total construction costs for the single purpose facility (flood control) and for a multi-purpose facility (flood control and water conservation) are summarized below.

Project	1964 costs	1970 costs[1]
Single purpose flood control		
a. 4,000 a.f. Res.	$1,064,000	$1,520,000
b. 2,000 a.f. Res.	720,000	1,030,000
Flood Control and Water Conservation		
No. res. for flood control	1,204,000	1,720,000
1500 a.f. for flood control	1,589,000	2,270,000
2300 a.f. for flood control	1,789,000	2,550,000

[1] 1970 costs are based on the ENR cost index.

Conclusions: It was recommended that a 2,000 acre-foot single purpose reservoir be built at Site 1 with no reservation for flood control.

Comments: Based on the information contained in this report, it did not appear that sufficient information was collected and studies run to properly evaluate the alternatives. This may have been a student paper.

DAM AND RESERVOIR SITE ON PENITENCIA CREEK

The name of this project is "Penitencia Creek Dam and Reservoir". The engineering feasibility study was made by the former Santa Clara Valley Water Conservation District and the work was completed in 1956. The engineering and geologic analysis was preliminary in scope. The purpose of this investigation was to establish the engineering and economic feasibility of constructing a dam and reservoir on Penitencia Creek for the conservation of local runoff for ground water recharge and flood control.

The project was located on the South Fork of Penitencia Creek about 6 miles from San Jose and one mile upstream of the falls. The drainage area above the reservoir is 13.23 square miles.

The project consists of an earth filled dam on the South fork of Penitencia Creek, a concrete lined chute type spillway and gated outlet works.

Hydrology:

Drainage area - 13.23 square miles
Average annual yield - 2560 Ac. Ft.

Dam and Reservoir Design Criteria:

1. Type of dam - earth filled with rock facing
2. Height of dam above stream bed - 170 feet
3. Crest length of dam - 455 feet
4. Fill Quantity - 890,000 cy.
5. Spillway design capacity - 7000 cfs.
6. Maximum water surface elevation - not known
7. Freeboard - 15 feet
8. Reservoir capacity - 4500 A.F.

The geologic investigation consisted of a very preliminary aerial survey, and it was determined that the foundation materials were acceptable and that adequate construction materials exist at the site.

In the operation of the project, local runoff from the South fork of Penitencia Creek was stored during the runoff season and released into Penitencia Creek for diversion to off stream percolation ponds near Piedmont Road. It was estimated that the percolation ponds could be operated for 3 additional months in the year and on the average about 2560 acre feet of water (average annual yield) could be recharged. By proper operation, storage space could be provided for flood control and it was estimated by the Santa Clara County Flood

Control and Water District that about $336,000 worth of channel improvements could be eliminated.

The total construction cost based on 1955 prices was estimated to be $1,204,000. Based on the ENR cost index the estimated present cost (1970 prices) is about $2,230,000.

Recommendations: This project was found to be economically feasible and recommended for construction. Based on the location of the reservoir, it was not considered feasible to develop recreation facilities.

Comments: In this study no attempt was made to establish benefits and allocate costs to separate purposes. Assuming that the development of a park facility at this site is not economic, the total costs could be allocated between flood control and water conservation. Considering the estimated yield from this reservoir and estimated cost, it appears that this site should be studied in greater detail.

DAM AND RESERVOIR SITE ON PENITENCIA CREEK

This is part of a Flood Control Study on Penitencia Creek (CE 168 Project) done by the University of California in Berkeley, California. The report was completed in 1967 and the study was preliminary in scope. The purpose was to investigate the economies of providing storage in upstream reservoirs to control the downstream flood flows to 1000 cfs and 2000 cfs. Downstream channel improvements were also considered for the 2000 cfs downstream flow alternative.

Four possible reservoir sites were investigated. Site A was located on the main stream about 1.5 miles upstream from Piedmont Road. Site B was on the main stream just below the confluence with the south branch (Arroyo Aquoque). Site C was on the south branch about 2.1 miles upstream from the confluence with the main branch. Site D was on the south branch about 3.6 miles upstream from the confluence with the main branch. Sites B and D were eliminated based on preliminary cost estimates.

The reservoir projects consisted of an earth fill dam, morning-glory type spillway and gated outlet works.

Hydrology:

		Site A		Site C	
		Alt. No. 1*	Alt No. 2*	Alt. No. 1*	Alt No. 2*
1.	Single Res. Facility				
a.	peak discharge 50 year storm	3500	3500	2240	2240
b.	Storm duration	12 hours		10.5 hours	
c.	Storage requirement	1060 A.F.	540 A.F.	560 A.F.	330 A.F.
d.	Computed outflow	960	1942	630	965
2.	Sites A & C Combined				
a.	Peak Discharge	2180	2475	2240	2240
b.	Storm duration	10 hours	10 hours	10.5 hrs.	10.5 hrs.
c.	Storage requirement	572 A.F.	185 A.F.	560 A.F.	330 A.F.
d.	Computed outflow	960	1942	630	965

* Alternative No. 1 is based on improving the downstream channel to a 2000 CFS capacity and Alternative No. 2 is based on no downstream improvements.

Dam and Reservoir:

		Site A Alt. No. 2	Site C Alt. No. 2
1.	Type of dam	Earth fill with rock facing	
2.	Top of dam elevation	407 feet	1197 feet
3.	Height of dam	52 feet	90 feet
4.	Side slopes	3:1	3:1
5.	Flood Control Storage	250 A.F.	1180 A.F.
6.	Spillway (morning-glory)	6.5 ft. in dia.	4.5 ft. in dia.
7.	Emergency Spillway	brodcrested weir	brodcrested weir
8.	Elev. Top of Sediment pool	386 feet	1132 feet
9.	Elev. top of flood control pool	402 feet	1192 feet
10.	Dam crest width	30 feet	30 feet
11.	Emergency spillway cap. (Brodcrested weir)	not given	not given
12.	Fill Quantity	90,000 CY.	230,000 CY.

Two levels of flood protection were considered for sizing reservoirs, one based on a discharge of 1000 cfs (existing downstream channel capacity) and a second based on a discharge of about 2000 cfs. (improved downstream channels). Storage cost curves for the 4 reservoir sites were drawn and sites B and D were eliminated. Cost curves for channel improvements and upstream reservoirs at Sites A and C that would control the 50-year storm indicated that channel improvements are more expensive than reservoirs and the least costly alternative was to build two reservoirs with no downstream improvements. The estimated cost of both dams was $570,000 (1967 prices) and, based on 1970 prices is about $725,000. The approximate cost (1967 prices) of Site A was $180,000 and for Site C was $390,000.

Recommendation: It was recommended that two reservoirs be built on Penitencia Creek (Sites A and C) to control the flow downstream to 1100 cfs. The least costly alternative was to provide 250 A.F. of storage at Site A and 1180 A.F. of storage at Site C.

Comments: No attempt was made to consider other purposes (water supply and recreation) and the allocation of costs since the construction of reservoirs was found to be the cheaper alternative when all the costs were assigned to flood control. Since these reservoirs are small, the economics of including water supply by enlarging the reservoir capacity should be investigated. Due to the steep side slopes at Site C, it may be difficult to develop recreation facilities at this site; however, recreation facilities could be developed at Site A and should be considered.

DAM AND RESERVOIR SITE ON PENITENCIA CREEK

The name of this project is "Penitencia Creek Flood Control and Water Conservation Investigation". The study was done by Whipple, Adamson, Murphy and Pearson Consulting Engineers, Inc., (Palo Alto, California) for the Santa Clara County Flood Control and Water District in November 1959. The engineering and geologic investigation was preliminary in scope and considered two facilities, one for flood control and one for flood control and conservation. The purpose of this investigation was to study the feasibility of constructing a dam or series of dams that would control the downstream runoff to 1,200 cfs and provide some measure of water conservation.

In this study 3 dam and reservoir sites were selected (1) Site A located on Penitencia Creek about one mile upstream from Toyon Avenue, (2) Site B located on Penitencia Creek just downstream from the confluence with the north and south branches about 3 miles upstream from Toyon Avenue, and (3) Site C located on the South Branch of Penitencia Creek about 2 miles upstream from the confluence with the North Branch and 5 miles upstream from Taylor Avenue.

The project consisted of an earth fill dam with rock facing, a concrete lined chute type spillway, and gated outlet works.

Hydrology:

a. Peak discharge - 3,200 cfs (50-year Flood) at Toyon Avenue.
b. Downstream channel capacity - 1,200 cfs.
c. Storage requirement to contain design flood -718 acre feet. Add 50% to storage requirement to allow for secondary peaks - total storage - 1,077 acre-feet.

Dam and Reservoir

Flood Control Only

	Site A	Site B	Site C
Type of dam	earth fill	earth fill	earth fill
Height of dam	105 feet	163 feet	-
Crest of dam	30-feet wide	30-feet wide	-
Side slopes	5:1	5:1	
Freeboard	10 feet	10 feet	-
Reservoir Storage	1200 acre-feet	1130 acre-feet	-

Flood Control and Conservation

Type of dam	earth fill	earth fill	earth fill
Height of dam	129 feet	190 feet	-
Storage Capacity	2000 A.F.	1730 A.F.	-
Storage for Conservation	923 A.F.	923 A.F.	-
Freeboard	10 feet	10 feet	10 feet

No attempt was made to ascertain dam foundation conditions or if the material available at the site is acceptable for construction.

The single purpose flood control reservoir would remain empty and drawn down as rapidly as possible after filling. The conservation storage component of the multi-purpose reservoir would be filled early in the runoff season and the flood control storage component would be operated as described above.

The total construction costs based on 1959 and 1970 prices is summarized below:

Project	Site A	Site B	Site C
	1959 Prices		
Single purpose Dam & Res.	$1,180,000	$1,880,000	-
Road Relocation	110,000	10,000	-
Total	1,290,000	1,890,000	
Multi-purpose Dam & Res.	$2,200,000	$3,000,000	-
	1970 Prices		
Single-purpose Dam & Res.	$2,260,000	$3,300,000	-
Multi-purpose Dam & Res.	3,850,000	5,250,000	-

The above costs do not include land and rights-of-way. This could be a sizeable amount for Site A, but would be small for Site B. Site C was not considered to be economically feasible for flood control or conservation and was eliminated. The cost of conserved water at Site A is $985 per acre foot and at Site B is $1,220 per acre foot, all based on 1959 prices.

The combination of Sites A and B were considered for both water supply and flood control purposes, and this combination was not found to be economically feasible.

Recommendations: Considering recreation and possible coordination with the California Water Plan in addition to the flood control and conservation features, Site A should be selected for more detailed study.

Comments: In this study, costs were established for a single purpose flood control and multi-purpose flood control and water supply project. Based on estimated costs it does not appear that the single-purpose project is justified.

No attempt was made to establish benefits and allocate costs in the multi-purpose project. However, considering the low yield and high costs, it does not appear that this project is economically feasible, even if recreation was considered as a separate purpose.

DAM AND RESERVOIR SITE ON PERMANENTE CREEK

The name of this project is "Permanente Creek Dam and Reservoir". The engineering feasibility study was made by the former Santa Clara Valley Water Conservation District and the work was completed in 1956. The purpose of this study was to establish the engineering and economic feasibility of constructing a dam and reservoir on Permanente Creek for the conservation of local runoff for ground water recharge and domestic purposes and flood control. This was part of the District's 1956 report on waste water salvage projects.

The project is located on the South Fork of Permanente Creek just upstream from the ferro-silicon plant of the Permanente Cement Company.

The project consists of an earth filled dam, concrete lined chute type spillway and gated outlet works.

Hydrology:

Drainage area - 2.7 square miles
Average annual yield - 660 A.F.

Dam and Reservoir Design Criteria:

a. Type of dam - earth filled dam with rock facing
b. Height of dam above stream bed - 195 feet
c. Crest length of dam - 600 feet
d. Fill quantity - not available
e. Spillway capacity - 3,000 cfs.
f. Reservoir storage - 1,400 acre feet

This reservoir would be operated for both flood control and water conservation. It was intended that a portion of the average annual yield of 660 acre feet be allocated to meet domestic demands (no amounts given) and the remainder released into Permanente Creek for downstream recharge. The estimated annual waste of water without the project was estimated to be 3,000 A.F.

The total construction cost based on 1955 prices was estimated to be $1,320,000. Based on present (1970) prices, this cost is estimated to be $2,440,000.

Recommendations: This project was considered economically feasible and recommended for construction in the March 8, 1956 report and considered uneconomic and not proposed for construction in the revised 1956 report.

Conclusions: Considering the cost of this facility, the low yield and the existing flood control improvements downstream, it does not appear that this project is economically feasible, even though an additional purpose (recreation) was considered and costs allocated.

DAM AND RESERVOIR SITE ON SAN FRANCISQUITO CREEK

The title of this study is "Alternative Method of Flood Control-San Francisquito Creek, California." This is a study done by Mr. James R. Vincent in 1968 as a project on Engineering-Economic Planning, Stanford University. The purpose of this study was to examine proposed alternatives utilizing one set of criteria so that the economic feasibility of these alternatives can be compared. The common criteria adopted was a restudy of the hydrology and a determination of the minimum downstream improvements needed to provide adequate channel capacity to pass major floods.

The dam and reservoir site considered was the Ladera Dam as proposed by the Corps of Engineers. The site is located 4,000 feet west of Alpine Road on San Francisquito Creek. This project includes an earthfill dam, concrete lined spillway, a high level ungated outlet works and a low level gated outlet works. Also included are two dikes adjacent to San Hill Road.

Hydrology

The following is a comparison of flood discharge - frequency relationships.

Return Period	Selected Analysis (cfs)	Corps of Eng. (cfs)	Univ. of Stanford Board (cfs)	Gumble Analysis cfs
200	7900			
100	7000	9400	7100	6440
50	6100	7500	6250	5620
20	4800	5500	5000	4520
10	4900	4000	4100	3670
5	2900	2800	3050	2790
2	1400	1300	1300	1450

Channel Improvements: A simulation model was programmed and water surface profiles established for a range of discharges ranging from 3,000 to 8,000 cfs. The minimum channel capacity considering present conditions was estimated to be 4,000 cfs. for a short reach of the channel and 5,000 cfs. or greater for the remainder of the channel.

Alternatives Considered
Channel Improvement

Alt. No. 1 - A 6,000 cfs. interim channel to provide minimum flood control protection (maximum flood of record).

Alt. No. 2 - A 6,000 cfs. permanent channel (channel widening and sack-concrete lining) to provide for the maximum recorded flood.

Alt. No. 3 - A 7,000 cfs. channel - This requires channel widening dikes and permanent bank protection.

Reservoir Alternative

Alt. No. 1 - Multipurpose Reservoir

The reservoir considered for this alternative had a storage capacity of 13,100 acre-feet and was located at the Ladera Damsite. The first cost based on 1968 prices was estimated to be $23,300.00 and the annual cost was estimated to be $888,000 including O.M. 7 R. costs. The Corps of Engineers estimate based on 1959 prices for a 12,600 acre-feet reservoir was estimated to be $8,389,000.

Alt. No. 2 - Single purpose flood control reservoir.

The current Corps of Engineers proposed 9,600 AF reservoir was considered for this alternative. The first costs based on 1968 prices was $17,800,000 and the annual cost was $630,000 including OM&R costs.

Alt. No. 3 - Stanford Reservoir

This proposal considers a 3,700 AF reservoir at the Ladera site. The first cost based on 1968 prices was estimated to be $7,050,000 and the annual cost was estimated to be $372,000 including OM&R costs.

In addition to the above improvements, the Corps of Engineers alternative to construct a 9,400 cfs channel, the Wilsey & Ham channel improvement proposal and the proposal to divert 2,400 cfs to the existing channel were considered.

Benefits: The following is a summary of first costs, annual costs, benefits and benefit-cost ratio for the alternatives considered.

Alternative	First Costs	Annual Costs	Benefits	Benefit-Cost Ratio
1. Ladera Dam (M.Purpose)	$23,300,000	$888,000	$486,500	.55/1
2. Ladera Dam (Flood Cont.)	17,800,000	630,000	287,000	.46/1
3. Stanford Reservoir	7,050,000	372,000	356,500	.96/1
4. C. of E. Channel	20,600,000	733,000	287,000	.39/1

Alternative	First Costs	Annual Costs	Benefits	Benefit Cost Ratio
5. Wilsey & Ham Channel	$ 5,500,000	$380,000	$287,000	.75/1
6. Diversion Scheme	15,400,000	550,000	287,000	.52/1
7. Channel Alt. 1	250,000	44,000	156,000	3.55/1
8. Channel Alt. 2	850,000	85,000	162,000	1.91/1
9. Channel Alt. 3	1,360,000	120,000	232,000	1.94/1

Conclusions: The 7,000 cfs. channel improvement was selected as the best alternative and it was recommended that this improvement be constructed as soon as possible. The first phase of this work would be the reach from Bayshore Freeway to Newell Road. This would increase the channel capacity to 5,500 cfs.

DAM AND RESERVOIR SITE ON SAN FRANCISQUITO CREEK

The name of this dam and reservoir project is "Ladera Dam and Reservoir". This is the dam and reservoir project considered by the Corps of Engineers in their 1961 flood control investigation of San Francisquito Creek. This study was modified in 1962 to consider a single purpose flood control reservoir and a re-study of the overall flood control problem was requested in 1965. The re-study has not been completed.

The engineering and geologic investigation was done in the detail needed for economic justification. The purpose of the investigation was to establish the engineering and economic feasibility of constructing a multi-purpose dam and reservoir on San Francisquito Creek for flood control, water supply and recreation purposes. The flood control feature was considered in conjunction with downstream channel improvements.

The dam site is located on San Francisquito Creek about 4,000 feet west of Alpine Road just below its junction with Bear Creek.

The project consists of an earthfill structure (compacted impervious fill), a concrete lined spillway (ogee crest) on the north abutment, a high level ungated conduit through the spillway and a low level gated outlet works. In addition, 2 dikes are proposed adjacent to Sand Hill Road.

Two major projects are affected by this proposed facility (1) the A.E.C. Linear Accelerator that passes through the reservoir area and the Junipero Serra Freeway (proposed in 1965).

Hydrology:

a. Drainage area - 27.5 square miles
b. Average annual rainfall - 35.7 inches
c. Runoff

Flood Criteria	Peak Inflow CFS	Peak* Outflow CFS	Surcharge Storage A.F.	Max. F.C. Volume A.F.	Max. W.S. Elev. Ft.
Design Flood	7500	2000	--	8500	289
Std. Proj. Flood	11,000	5,400	1,000	9,500	292
Max. Prob. Flood	27,000	20,300	-	-	-

* Based on 8,500 acre feet of flood control storage.

Dam and Reservoir Design Criteria:

a. Type of dam - impervious earth fill with filter zone. Dikes were impervious earth fill without filter zone.

b. Crest length - 2200 feet; width 20'; elevation 302 feet (dam only).

c. Height of dam - 95 feet; height of dikes (average) 15 feet.

d. Side slopes upstream - 4:1; downstream - 3:1

e. Freeboard above spillway design flood - 5 feet

f. Spillway - ungated concrete ogee weir located near the left abutment - Crest length - 220 feet; Crest elevation - 289 feet (design discharge - 18,000 cfs). Flood control outlet - ungated 9' x 9' conduit in spillway floor elevation 258 feet (design discharge-2300 cfs). Combined capacity - 20,300 cfs.

g. Water conservation outlet - Includes inlet structure with trash racks and two 36-inch hydraulically operated emergency valves, 700 feet of 48-inch conduit and a downstream gate hydraulically operated. Capacity 415 cfs at W.S. elevation 258 feet and 100 cfs at W.S. elevation 210 feet.

h. Relocations
County roads - 0.5 miles
12-inch water line - 2.5 miles

i. Storage Capacity
Flood control 8,500 A.F. (top of pool elevation 289 feet)

Water Cons. 3,500 A.F. (top of pool elevation 258 feet)

Sediment - 600 A.F.

Total 12,600 A.F.

j. Fill Quantity
Compacted earth - 1,800,000 c.y.

Filter sand and gravel - 315,000 tons

Riprap - 62,000 tons

k. Land acquisitions-Dam and Reservoir 525 acres
Recreation 57 acres

Operation: The proposed reservoir would operate unattended with automatic releases of flood flows through the ungated spillway. For the design flood the maximum flow downstream is 3,000 cfs. It was estimated that the safe downstream channel capacity was 3,500 cfs.

Geology: A detailed surface investigation of the geology was made. Bedrock at the dam site is sandstone and shale with Eocene sandstone (comparatively soft) under the right abutment and most of the reservoir area. Miocene sandstone and shale (moderately hard) underlies the left abutment. The overburden is sandy clay or silt clay, and is about 15 feet deep in the valley areas and 10 feet deep on the abutments. A shallow swale exists at the right abutment. Foundation materials were considered acceptable for an embankment to the heights proposed. Except for filter materials, construction materials exist at the site. No subsurface exploration was made.

Costs:

First Costs:	1959 Costs	1970 Costs
Land	$2,570,000	$7,870,000**
Reservoir and Dam	4,929,000	8,626,000*
Relocations & Utilities	255,000	446,000*
Subtotal	$7,754,000	$16,942,000
Recreation Facilities	635,000	1,016,000*
Project Studies	76,000	76,000
Total	$8,465,000	$18,034,000

Net Federal first cost is $4,747,000. (Total cost includes $76,000 for Survey report).

Total non-Federal first cost is $3,642,000.

The above 1970 costs do not include work needed to protect the Stanford Linear Accelerator and for the relocation of Junipero Serra Freeway and the intersection at Sand Hill Road.

Annual Costs: Annual costs are based on a 50-year life and interest rates of 2-5/8% for Federal funds and 4% for non-Federal funds. The total annual charges were estimated to be $437,000 including $57,000 for recreation facilities.

* Based on ENR Cost Index ** Based on a Land Cost of $15,000/Acre.

Cost Allocation:

First Costs:

Item	Flood Control	Water Cons.	Total
Federal Construction	$ 4,112,000	-	$ 4,112,000
Non-Federal Construction	-	$ 817,000	817,000
Lands & Relocations	2,354,000	471,000	2,825,000
Total Non-Federal	2,354,000	1,288,000	3,642,000
Total	6,466,000	1,288,000	7,754,000
Rate	.834	.166	1.00

Annual Costs:

			Sub-Total	Recreation
Federal (Project)	155,000	1,000	$156,000	-
Non-Federal Project	134,000	67,000	201,000	$29,000
O.M.&R.	19,000	4,000	23,000	28,000
Total	$308,000	$72,000	$380,000	$57,000
B/C Ratio	1.6	1.1	1.5	-

Costs were allocated, exclusive of the costs of recreation facilities and pre-authorization studies, to the two primary purposes, namely, flood control and water conservation as shown above. Recreation was not considered a purpose for cost allocation.

The apportionment of costs among the interests is as follows:

Federal Costs - $6,035,000
Non-Federal Costs - $2,354,000
Total Project - $8,389,000

Benefits:

a. The total conservation benefit for water supply is $79,500 for 1,500 acre feet of firm yield. The price for water was based on a purchase price of $70 per acre foot from the Hetch-Hetchy system less the estimated cost of $17 per acre foot to treat local water.

b. The total benefits from flood control are $502,000. A breakdown is as follows:

Inundation	$446,000
Bank erosion	36,000
Annual cost of bank protection of	20,000
TOTAL	$502,000

c. Recreation benefits were estimated to be $160,000.

Alternative Studies Considered:

a. Multi-purpose dam and reservoir - 13,100 Acre Foot Reservoir

Storage capacity for	Flood Control	8,500 A.F.
	Water Cons.	3,500 A.F.
	Silt	1,100
Firm yield for Water	Supply	1,500 A.F.

Recreation - 80 Ac., 300,000 annual visitation

b. Flood Control and recreation reservoir - 13,100 A.F. Reservoir

Storage capacity for	flood control	8,500 A.F.
	recreation	3,500 A.F.
	silt	1,100 A.F.

Recreation area 80 acres - 300,000 annual visitors.

c. Flood control and Recreation Reservoir - 11,100 A.F. Reservoir

Storage capacity for	Flood Control	8,500 A.F.
	Recreation	1,500 A.F.
	Silt	1,100 A.F.

Recreation Area 80 Acres - 300,000 annual visitors

d. Flood Control and dry pool Reservoir - 9,600 A.F. Reservoir

Storage Capacity for	Flood Control	8,500 A.F.
	Recreation	0 A.F.
	Silt	1,100 A.F.

Recreation area 80 acres - 50,000 annual visitors

e. Flood Control only - Reservoir - 9,600 A.F. Reservoir

For this alternative to be used, the channel downstream must take up to 9,400 cfs.

Additional information on the size and capacity of facilities and costs was not available.

Conclusions: The District Engineer recommended construction of the project consisting of a multi-purpose reservoir with a capacity of 12,600 A.F., at an estimated cost of $8,389,000. Of this amount the estimated non-Federal cost would be $2,354,000 for the flood control function and $1,288,000 for the water supply function. The estimated Federal costs would be $6,035,000 of which $1,288,000 is for water supply.

Remarks: Considering the large difference between estimated 1969 and 1970 first costs, it does not appear that this project is economically feasible.

DAM AND RESERVOIR SITE ON SAN FRANCISQUITO CREEK

This is a general review of the Corps of Engineers Report on flood control for San Francisquito Creek dated January 1961 by Stanford University (R.K. Linsley & R. E. Lee). The primary feature of this study is the proposed Ladera Dam on San Francisquito Creek. The purpose of this review was to show that the Ladera Dam and Reservoir project is not economically feasible.

The dam and reservoir considered in this study was the facility proposed by the Corps of Engineers in their 1961 report (12,600 Acre Foot multi-purpose reservoir - estimated cost $8,465,000).

Hydrology:

University studies indicate that the Corps of Engineers have underestimated the return period for large floods. It appears that the 1955 flood return period was nearly 40 years and not 25 years as assumed by the Corps.

Dam and Reservoir Design Criteria:

No attempt was made to change the dam and reservoir facility described by the Corps.

Costs:

The University questioned land and construction costs. The following is a summary of revised costs based on 1959 prices:

First Costs

Construction	$4,911,000
Land and Damages	5,250,000
Sup. and Admin.	372,000
Engineering	415,000
Interest During Const.	374,000
Additional Accelerator Costs	250,000
Total	$11,572,000

Cost Allocation

Federal Costs	4,715,000
Non-Federal Costs	6,233,000
Total Costs	10,948,000

Annual Costs

Federal Costs	
Capital Recovery (2-5/8%)	$175,000
Linear Accelerator (2-5/8%)	9,000
Non-Federal Costs	
Capital Recovery (4%)	310,000
Maintenance and Operations	23,000
Total Annual Cost	$517,000

The revised land costs are based on a unit cost of $10,000 per acre and the construction cost was revised based on comments contained in a review by the State Department of Water Resources. The estimate of work needed to protect the linear accelerator was made by the University. The cost allocation of .834 to flood control and .166 to water supply as established by the Corps was not changed.

Benefits:

The Corps estimate of benefits and the benefits established by the University are summarized below:

	Corps	University
Inundation damage	$446,000	$312,000
Bank erosion prevented	36,000	25,000
Annual cost of bank protection	20,000	20,000
Total annual benefits	$502,000	$357,000
Water Conservation (1500 A.F. at $53/A.F.)	79,500	0
Total benefits	$581,000	$357,000
B/C ratio	1.53/1	0.7/1

Comments:

a. Interest rates adopted by the Corps appear to be low

b. The dual interest rate violates a principle of economy that allocation of cost between purpose should not affect the economic evaluation of the project.

c. The Corps' estimate of reduction in bank erosion is high. It appears that the safe flow in the downstream channels is 4,000 cfs and not 3,000 cfs.

d. Interest during construction should be higher when the patterns of expenditures during construction are considered.

Alternatives:

The Corps' alternative proposals were not evaluated (lack of adequate information). Alternative proposals submitted by other agencies are summarized below:

Agency	Cost	Description
S.C.C.F.C. & W.D.	$1,750,000	7,000 cfs channel
Kennedy Engineers (1959)	5,000,000	7,000 cfs channel

Conclusions:

The proposed Ladera Dam is not economically sound and the benefit cost ratio is in the order of 0.7:1 or less. The benefit-cost ratio computed by the Corps contains errors in computations and logic.

DAM AND RESERVOIR SITE ON SAN FRANCISQUITO CREEK

The name of this project is "Little Francis Project". The engineering feasibility study was done by the State Department of Water Resources as a part of their 1955 investigation of water resources and needs in Santa Clara County, (Bulletin No. 7). The investigation was preliminary and the purpose was to investigate the engineering and economic feasibility of constructing a dam and reservoir on San Francisquito Creek for domestic water supply purposes. Flood control and recreation were not considered.

The dam site was located on San Francisquito Creek about 6,000 feet west of Alpine Road and 5.4 miles upstream from Highway 101.

The dam and reservoir project would consist of an earthfill dam with a rock facing, concrete ungated ogee crest spillway on the north abutment and a gated outlet works. Also included is the relocation of .25 miles of Sand Hill Road and .15 miles of Whisky Hill Road.

Hydrology:

a. Drainage area 28.1 square miles
b. Mean seasonal runoff 12,300 acre feet
c. Safe seasonal yield (7,300 acre feet storage) is 3,000 acre feet.

Dam and Reservoir Design Criteria:

a. Type of dam - earthfill with an impervious core and 3 foot riprap facing.
b. Height of dam above stream bed - 91 feet
c. Top of dam elevation - 300 feet (stream bed elevation - 209 feet)
d. Side slopes - upstream 2.5:1; downstream 2.5:1
e. Crest width - 30 feet, Crest length - 1,365 feet
f. Reservoir Capacity - 7,300 Acre Feet (water surface area - 284 acres)
g. Fill Quantity - 431,000 Cubic Yards
h. Spillway - concrete lined chute type with ogee weir, maximum depth of water - 6 feet, design capacity - 9,000 cfs, crest length of 175 feet and 2,000 foot concrete lined chute.
i. Weir elevation - 290 feet
j. Outlet Works - 36-inches in diameter steel conduit with hydrologically operated 36-inch slide gate upstream and a 30-inch hollow jet valve on the outlet end.
k. Stilling Basin - 12 feet wide, 50 feet long and 10 feet high
l. Freeboard - 10 feet

Geology:

The geologic investigation was preliminary and did not include subsurface exploration. The foundation rock consists of Chico and Purisima formations (sandstones, siltstones and terrace sands and gravels) with deeply weathered joints and possible faults normal to the dam axis. Stripping is required, 5 feet of soil and rock on the right abutment and 2 feet of soil and 10 to 25 feet of rock on the left abutment. Foundations were considered to be suitable for an earthfill dam up to 100 feet in height. Construction materials are available at the site.

Costs:

The estimated construction cost of the Dam and Reservoir based on 1954 prices was estimated to be $2,202,000 and the annual cost based on a 3.5% interest rate is $104,000. Based on 1970 prices, the first cost is about $3,750,000 and the annual cost is about $275,000 (6% interest).

Conclusions:

The total cost per acre foot including the distribution system from the Little Francis Dam to the Water Treatment Plant, the water treatment plant, pumping station and distribution reservoir (total cost - 1954 prices - $3,377,000 and annual cost of $222,000) is $75. This project was considered uneconomic and consideration should be given to developing other sources of water supply.

Remarks:

The 1970 cost of water at the dam site is about $92 per acre foot, based on the States' estimate of O.M.&R. costs and a 6% interest rate. By considering recreation and flood control as separate purposes, the total cost could be allocated and possibly the unit cost of water lowered to a more realistic value. Based on the topography, it appears that the developable storage capacity of this site is limited.

DAM AND RESERVOIR SITE ON SAN FRANCISQUITO CREEK

This is a folder of letters and design computations for a dam and reservoir proposed for construction on San Francisquito Creek by Stanford University. The work was done by F. C. Herrmann, Consulting Engineer in 1933.

The damsite was located on San Francisquito Creek about 1.6 miles upstream from Alpine Road.

Dam and Reservoir Design Criteria

a) Crest Elevation - 295 ft., Crest Length - 1,100 ft.

b) Side slopes - 2-1/2:1

c) Creek bed elevation - 204 Ft.

d) Storage Capacity - 220 M.G.

e) Max. Water Surface Elev. - 226 Ft.

f) Max. Water Surface Area - 25 Acres

Remarks: The design computations did not appear to be complete and no information was found on total costs.

DAM AND RESERVOIR SITE ON SAN TOMAS CREEK

The name of this project is "San Tomas Creek Dams". The engineering feasibility study was done by the former Santa Clara Valley Water Conservation District in 1956. The engineering and geologic analysis was preliminary in scope. The purpose of this investigation was to establish the engineering and economic feasibility of constructing dams on San Tomas Creek for flood control with water conservation (ground water recharge) as an incidental purpose. This was part of the District's 1956 report on waste water salvage projects.

The major tributaries that form San Tomas Creek join the main channel on the valley floor and no single reservoir site exists for controlling runoff from this drainage. Since most of the reservoir sites have limited storage capacity only 2 sites, one on the main tributary of San Tomas Creek and one on Wildcat Creek were considered. The site on San Tomas Creek is just south of the Los Gatos-Saratoga Highway and the site on Wildcat Creek (a major tributary) is near Piedmont Road. Each project consists of an earthfill dam with rip-rap facing, a concrete lined chute type spillway and gated outlet works.

Hydrology: No data available.

Dam and Reservoir Design Criteria:

		Dam on Main Branch	Dam on Wildcat Creek
a.	Type of Dam	earth fill w/ rock facing	earth fill w/ rock facing
b.	Height of dam above stream bed	50 feet	35 feet
c.	Crest length of dam	-	-
d.	Fill quantity	-	-
e.	Spillway capacity	-	-
f.	Reservoir capacity	300 acre feet	150 acre feet

Adequate construction materials exist at the site and the foundations are acceptable for the construction of this type of structure.

The two reservoirs would be primarily operated for flood control and it was estimated that these facilities would control the peak discharges from the main branch of San Tomas Creek and Wildcat Creek. The controlled release of water after the flood flows subside would provide some measure of conservation. The estimated average annual wasted water was estimated to be 2600 Acre Feet.

The total construction cost based on 1955 prices was $350,000 for the facility on San Tomas Creek, the(main branch)and $153,000 for the Wildcat Creek facility. These costs based on 1970 prices are $645,000 and $280,000 respectively.

Conclusions:

The proposed reservoirs were considered to be adequate to control the flood flows in San Tomas and Wildcat Creeks. By controlling flood flows, it was assumed that additional percolation would result in the downstream channel. It was recommended that these two dams be constructed.

Comments:

Considering the flood control improvements completed by the District and the cost of these storage facilities, it does not appear that upstream storage is feasible. The benefits to water conservation would probably be too small to consider and the allocation of a portion of these costs to recreation may not be enough to justify the project.

DAM AND RESERVOIR SITE ON SILVER CREEK

The title of this report is "Estimate of the Construction Cost of the proposed Silver Creek Dam". This study was done by Nisich Gyler, Santa Clara University in 1957. The investigation was preliminary in scope. The purpose was to establish the engineering and economic feasibility of constructing a dam and reservoir on Silver Creek for water conservation.

The dam site is located on Silver Creek about 2 3/4 miles upstream from Loupe Avenue.

The project consists of a rolled earthfill dam, side channel concrete lined spillway and gated outlet works.

Hydrology:

a. Drainage area - 7.84 square miles
b. Average annual runoff - 940 acre feet

Dam and Reservoir Design Criteria:

a. Type of dam - rolled earthfill with rock facing.
b. Crest width - 30 feet; crest elevation - 442 feet
c. Fill quantity - 675,500 cubic yards
d. Downstream slope - 2.5:1; upstream slope - 3:1
e. Spillway crest elevation - 427.5 feet; freeboard - 15 feet
f. Spillway capacity - 1,000 cfs
g. Maximum pool elevation - 427.5 feet

Total construction costs based on 1957 prices is $1,304,800. This includes $160,000 for right-of-way. This total cost based on 1970 prices (based on ENR cost index) is about $2,540,000.

No conclusions were given.

Remarks:

No attempt was made to study the economics of constructing a water supply facility on Silver Creek in detail. The hydrology and cost estimates are very preliminary and no attempt was made to study alternatives and offer conclusions and recommendations. It appears that this was a student paper and not intended to be a complete report.

DAM AND RESERVOIR SITE ON SILVER CREEK

The name of this project is "Silver Creek Dam and Evergreen Distribution System". The engineering feasibility study was made by the former Santa Clara Valley Water Conservation District and was completed in 1956. The engineering and geologic investigation was preliminary in scope. The purpose of this investigation was to establish the engineering and economic feasibility of constructing a dam and reservoir on Silver Creek with a diversion from Dry Creek and a distribution system for water conservation (ground water recharge) purposes.

The storage facility was located on Silver Creek about 2 3/4 miles upstream from Loupe Avenue. The diversion from Dry Creek to Silver Creek was located at the low elevation saddle between the two drainages.

The project consists of an earth fill dam on Silver Creek with provisions to be ultimately enlarged, if needed, to a size capable of storing up to 32,500 acre feet. This is the storage requirement if this site is selected as the terminal facility for the State's South Bay Aqueduct. In addition, a diversion dam and canal would be constructed to divert flows from Dry Creek and a pump station and canal constructed between the Silver Creek Reservoir and the Evergreen Canal for transporting water to the Evergreen area for recharge and surface irrigation. This would also require an enlargement of the downstream portion of the existing Evergreen Canal to 30 cfs.

Hydrology:

a. Drainage area - 7.8 square miles
b. Average annual yield - 940 A.F.

Dam and Reservoir Design Criteria:

a. Type of dam - earth fill with rock facing.
b. Height of dam above stream bed - 77.5 feet (elev. 442.5)
c. Crest length - 850 feet
d. Fill quantity - 655,000 cubic yards
e. Spillway capacity - 2,500 cfs.
f. Maximum water surface elevation 427.5 (15 feet of freeboard)
g. Reservoir capacity - 2,500 acre feet
h. Outlet works - gated conduit through the dam. Capacity -20 cfs.
i. Pump Station - located at the dam with a capacity of 20 cfs and a total pumping head of 55 feet.
j. Distribution System - 1000 feet of pipeline, 1½ miles of canal and an enlarged Evergreen Canal easterly of the saddle.

The geologic investigation consisted of a very preliminary aerial survey and it was determined that the site was acceptable.

The Silver Creek Dam and Reservoir would be operated to serve two purposes; conservation and flood control. For the conservation purpose, local runoff from the Silver Creek drainage and diverted runoff from the Dry Creek drainage would be stored in the Silver Creek Reservoir. Based on a storage capacity of 2,500 acre feet, the average annual yield is 940 acre feet. Since no percolation capacity exists in the downstream reaches of Silver Creek, this water would be pumped into a proposed canal to be constructed between the Silver Creek Reservoir and the Evergreen Canal. This water would be delivered to the Evergreen area for groundwater recharge and surface irrigation through an enlarged reach (30 cfs) of the existing Evergreen Canal. When storage space is available, this reservoir would also be used to store water pumped from Coyote Creek. Considering the small yield, the primary purpose of this reservoir is flood control. It was estimated that the proposed Silver Creek - Coyote Creek diversion could be eliminated since adequate storage would be available to contain the design flood. No information supporting this statement was found.

The total construction cost (1955 prices) was estimated to be $891,000. Based on the ENR cost index, the estimated present cost (1970 prices) is about $1,650,000. The estimated cost of water based on 1955 prices is about $35 per acre foot with local financing and $24/acre foot with Federal Aid.

Recommendations:

This project was considered economically feasible and recommended for construction as a conservation and flood control facility.

Comments:

Recreation has not been considered for this project and no attempt was made to establish benefits and allocate costs to the separate purposes. Considering the potential recreation benefits and limited flood control benefits based on proposed downstream channel improvements, it may still be possible to justify this project for water supply and recreation based on the higher 1970 costs.

DAM AND RESERVOIR SITE ON SILVER CREEK

The name of this project is "Evergreen Reservoir". The engineering study was done by the State Department of Water Resources as a part of the California Water Plan.

The engineering and geologic analysis was preliminary in scope. The purpose of this investigation was to establish the engineering and economic feasibility of constructing a dam and reservoir on Silver Creek to provide regulatory storage for South Bay Aqueduct deliveries. This project was abandoned when the terminus of the South Bay Aqueduct was moved from the Pajaro River to Los Coches Creek.

The dam site was located on Silver Creek about 2 3/4 miles upstream from Loupe Avenue and 6 miles Southeast of San Jose.

The project consists of an earthfill dam, ungated concrete-lined spillway and combined gated inlet and outlet facility.

Hydrology:

This information is not available.

Dam and Res. Design Criteria:

Type of dam - earthfill with rock facing

Height of dam - 197 ft.

Elevation of normal pool - 538 ft.

Reservoir capacity - 31,700 AF

Costs:

The total construction cost based on 1957 prices is about $7,090,000. The total cost based on 1970 prices is about $12,800,000.

Mr. D. Finlayson, State Department of Water Resources was not able to locate any additional information on this project in the State files.

DAM AND RESERVOIR ON SOQUEL CREEK

The name of this project is "Soquel Project". The study was done by Creegan and D'Angelo, Civil Engineers for the former Santa Clara Valley Water Conservation District in May 1960. The study was preliminary in scope and divided into two phases with only the first phase completed. The purpose of this study was to establish the feasibility of storing surplus runoff in Soquel Creek located in Santa Cruz County and diverting this water through the old railroad tunnel at Laurel into Los Gatos Creek for ground water recharge in North Santa Clara County. In addition, some measure of flood control would be provided on Soquel Creek for Santa Cruz County.

Two dam and reservoir sites were investigated, one called the "Lower Site" located just below the confluence of the west and east forks about 4 miles north of Soquel and a second called the "Glenwood Site" located on the west fork just downstream from Glenwood.

The project would consist of an earth fill dam, spillway (concrete lined) and gated outlet works on Soquel Creek, a pump station at the reservoir and a pipeline up the west fork of Soquel Creek extending through the abandoned railroad tunnel at Laurel terminating in the Los Gatos Creek watershed.

The first phase work covered the hydrology and established vary preliminary cost estimates. Engineering and geologic investigations were exploratory in scope, whereas the hydrologic investigation was considered detailed in scope.

Hydrology:

	Lower Site	Glenwood Site
Watershed area	31.5 sq. mi.	7.8 sq. mi.
Safe Annual Yield	15,000 AF	3,000 AF
Average Annual Yield	21,600 AF	3,700 AF
Average Annual Runoff	25,000 AF	6,100 AF
Annual Fish Release	1,900 AF	400 AF

Dam and Reservoir Design Criteria:

Type of Dam	Earth fill	Earth fill
Crest Width	30 feet	30 feet
Height of dam	205 feet	148 feet
Downstream/upstream slopes	2:1/3:1	2:1/3:1
Fill Quantity	4,500,000 Cubic Yards	672,000 Cubic Yards
Freeboard	13 feet	13 feet
Reservoir Capacity	40,000 AF	5,050 AF

	Lower Site	Glenwood Site
Reservoir Surface Area	530 AC	88 AC
Length of Pipeline	32,050 feet	16,390 feet
Pumping Head	921 feet	852 feet
Pump Stations & HP	2 at 1600 HP	1 at 560 HP

The geologic investigation consisted of a preliminary aerial survey. A more detailed study was to be included in the Phase II work. No attempt was made to complete a geologic investigation of the site.

This project would be operated to conserve the surplus runoff in Soquel Creek for diversion to the North Santa Clara County area for recharge purposes. Water rights applications were filed for a total development of 14,050 acre feet per year on behalf of Santa Cruz County by the State. This right would be relinquished to any public agency developing such water for purposes indicated. Existing permits and licenses for water amount to 1723 acre feet per year.

Costs:

The following costs based on 1960 prices were established for each site:

	Lower Site	Glenwood Site
Total Capital Cost	$8,980,700	$2,189,100
Annual Cost (Dam)		
50 yrs. @ 4%	307,700	71,700
O & M	20,000	12,000
Annual Costs (pump station)		
25 yrs @ 4%	151,700	41,500
O & M	23,000	10,000
Power Costs	151,500	21,200
Total Annual Costs	653,900	156,400
Cost Per Acre Foot	48.43	57.90
Total Capital Costs Based on 1970 Prices	$15,700,000	$3,800,000

Conclusions:

The costs of $48 and $58 per acre foot to develop water on Soquel Creek for export to Santa Clara County are high and do not compare with the cost of importing water from other sources.

Comments:

Assuming that water rights could be established and a contract signed for the export of water from Santa Cruz County, this project may be economically feasible if recreation and Flood Control were considered and costs allocated to the 3 purposes. In consideration of the small yield from the Glenwood Site, it does not appear that this site is feasible. However, the Lower Site with its larger yield, should be investigated in greater detail.

DAM AND RESERVOIR STUDIES RELATED TO DISTRICT'S SOUTH COUNTY PLANNING STUDY

As a part of the District's South County Planning Study, several dam and reservoir sites located in the southern part of Santa Clara County were selected for a reconnaissance investigation to establish very preliminary costs of developing these sites for water supply or water supply and flood control purposes. These studies were completed in 1968 and no attempt was made to refine design criteria, compute benefits and allocate costs. Recreation as a purpose was not considered.

The projects considered and the location are shown below:

	Project Name	Location
1.	Upper Little Arthur Creek Dam and Reservoir	On Little Arthur Creek about 2.4 miles upstream from Watsonville Road.
2.	Lower Little Arthur Creek Dam and Reservoir	On Little Arthur Creek about 1.3 miles upstream from Watsonville Road.
3.	Bodfish Creek Dam and Res.	On Bodfish Creek about 1.0 miles westerly of the intersection of Watsonville Road and Highway 152.
4.	Llagas Creek Dam Dam and Reservoir	On Llagas Creek about 1.3 miles west of McKean Road along Cosa Loma Road at the entrance to Ryan Canyon.
5.	Chesbro Dam and Reservoir	This is a proposal to raise existing Chesbro Dam.
6.	Gilroy Dam and Reservoir	On Uvas Creek just downstream from the confluence with Bodfish Creek. (This is the C. of E. Gilroy Reservoir Site).
7.	Cedar Creek Dam and Reservoir	On Cedar Creek about 0.6 miles upstream from the confluence with Pacheco Creek.
8.	Pacheco Lake Reservoir	On Pacheco Creek about 0.6 miles upstream from Highway 152. (This is an enlargement of the existing Dam and Reservoir).

9.	Cedar-Pacheco Creek Dam and Reservoir	On Pacheco Creek just downstream from Harper Canyon.
10.	Packwood Creek Dam and Reservoir	On Packwood Creek in Packwood Valley about 5 miles northeast of Anderson Dam.
11.	Coyote Creek Dam and Reservoir	On Coyote Creek about 1.0 miles downstream from the confluence with Canada Creek.
12.	Uvas Dam and Reservoir	This is a proposal to raise the existing Uvas Dam.

Each project would consist of an earthfill dam with rock facing (includes the enlargement of existing dams), concrete lined ogee crest, ungated spillway and gated outlet works.

The following criteria was established:

Project	Drainage Area Sq. Mi.	Mean Ann. Runoff AF	Safe Ann. Yield AF	100 yr. Flood Peak AF	500 yr. Flood Peak Cfs.	Spillway Cap Cfs.
Upper L. Arthur	6.5	1950	1520	2100	4600	4600
Lower L. Arthur	8.1	2420	1870	2600	5300	5300
Bodfish Creek	10.2	2550	2050	2800	5600	5600
Llagas Creek	8.7	6940				
Chesbro*	18.9	4870				
Gilroy	64	9530				
Cedar	–	4170				
Pacheco Lake*	67.0	10,700				
Cedar-Pacheco	–	–				
Packwood	5.1	1353				
Coyote Creek	110.0	32,100				
Uvas*	30.3	13,050				

* Enlargement of existing facilities.

Project	Height of Dam Ft.	Crest Length Ft.	Crest Elev. Ft.	Fill Quantity CY X 10^3	Reservoir Storage				Max. Surf. Area AC.	Spillway Crest Elev.	Outlet Works	
					Flood Control AF	Water Supply AF	Silt AF	Total AF			Capacity CFS	Size Inches
Upper L. Arthur	[1]143	865	583	1,030	-	7560	780	8340	198	572	4.2	24
	[2]155	890	595	1,275	2100	7560	780	10440	210	584	4.2	24
Lower L. Arthur	[1]125	1830	485	1,730	-	9370	960	10330	241	472	5.2	24
	[2]139	2000	497	2,320	2600	9370	960	12930	251	472	5.2	24
Bodfish	[1]145	1080	499	1,500	-	9890	1220	11110	217	486	5.7	24
	[2]159	1130	513	1,895	2800	9890	1220	13910	245	500	5.7	24
Llagas Cr.	110	950										
Chesbro Dam*	+57	+460	591									
Gilroy	30	3400										
Cedar	*72	1000		629				8000		460		
Pacheco Lake	+82	+600		485				5000				
Pacheco-Cedar	65	1550		802				15000		365		
Packwood	40	1100		228				4000		1400		
Coyote Cr.	156	1040		2,932				9600		988		
Uvas*	+57	+250										

[1] Water supply
[2] Water supply and flood control
* Enlargement of existing facilities
+ Indicates additional height and crest length

Costs:

The following costs based on 1968 and 1970 prices are summarized below:

Project	1968 Costs		1970 Costs	
	Water Supply	W.S. & Flood Control	Water Supply	W.S. & Flood Control
Upper L. Arthur				
First Cost	$3,521,000	$4,034,000	$4,100,000	$4,700,000
Ann. Cost	182,000	207,000		
Cost/AF	120	106		
Lower L. Arthur				
First Cost	$5,309,000	$6,175,000	$5,850,000	$7,200,000
Ann. Cost	273,000	318,000		
Cost/AF	146	133		
Bodfish				
First Cost	$4,570,000	$5,436,000	$5,300,000	$6,350,000
Ann. Cost	236,000	280,000		
Cost/AF	115	106		

Comments:

These studies were done as a reconnaissance of the South County area to determine if any reservoir sites in this area look promising. Since costs (except for L. Arthur and Bodfish Creeks) have not been established for the remaining sites, it is difficult at this time to evaluate the studies.

DAM AND RESERVOIR SITE ON STEVENS CREEK

The name of this project is "Investigations of Water Resources of Stevens Creek, Santa Clara County, California - Including Design of Flat Slab Type Dam". This is a thesis for the degree of Engineer, (Stanford University) done by Mocholos T. Yokanin in August 1931. The purpose of this study was to estimate runoff and determine the economies of constructing a storage facility on Stevens Creek for ground water recharge and domestic use.

The damsite was located at the southeast corner of Section 33, T 7S, R 2W about 3/4 mile upstream from the confluence of Swiss and Stevens Creek and about 1 mile upstream of the existing dam.

The project consists of a flat slab buttress type concrete dam, overflow spillway section and gated outlet works.

The geologic investigation was a preliminary aerial survey of the area. The rock formations on the Stevens Creek drainage are sedimentary (Santa Clara and Franciscan formations) and igneous (diabase and basalt). The San Andreas Fault is northwest of the damsite and a fracture zone passes through the possible damsite areas. The fracture zone and the area occupied by the Santa Clara formation are the only areas where leakage would be a problem.

Hydrology:

a) Drainage area-12.8 square miles

b) Average annual rainfall-25" to 50"

c) Runoff estimated, based on a correlation study utilizing measured flows on Coyote Creek. (1902 to 1929)

Maximum runoff at damsite	27,000 AF
Average runoff at damsite	8,620 AF
Minimum runoff at damsite	0 AF

d) Losses in the reservoir estimated to be 900 AF/yr.

e) Maximum expected flood 25,000 cfs.

f) Average annual yield-2,240 AF (based on a storage capacity of 5,200 AF.

Dam and Reservoir Design Criteria:

a) Type of dam-Hollow flat slab buttress type concrete dam.

b) Stream bed elevation 650 feet.

c) Height of dam 170 feet.

d) Crest elevation 820 feet, crest length 840 feet.

e) Spillway - overflow type at 2 bay sections of dam near east abutment with taintor gate control. Chute section was 32' wide and 8'6" deep. Design flow + 25,000 cfs.

f) Outlet work-A 36" steel pipe with slide gate control upstream floor elevation 675 feet. Q = 82.5 cfs. (max.)

g) Reservoir storage capacity-5,200 AF.

The cost of the dam based on 1931 prices was about $1,300,000. This cost based on 1970 prices is about $2,600,000. This cost does not include land and relocations.

Comments: It is economically feasible to construct a concrete dam on Stevens Creek for water supply. Considering the location of the San Andreas Fault the flat slab buttress type dam that can adjust to foundation movements is an acceptable structure for this area.

Remarks: This study did not consider flood control and recreation as separate purposes and no attempt was made to allocate costs. Considering the 1970 cost of $2,600,000 as a water supply cost, (this is low because land and relocations have not been included) the unit cost of water (6% interest) would be over $70/AF.

DAM AND RESEVOIR SITE ON TIMBER RIDGE

The name of this project is "Report on a Preliminary Feasibility Study of a Pumped-Storage Hydroelectric Power Development at Coyote Reservoir". The study was done by the Santa Clara County Flood Control and Water District and the first draft was completed in March 1969. The study was exploratory in scope and consisted of an excavated and diked high elevation reservoir, tunnel and penstock, low level reversible Francis-type pump-turbine units, and underground powerhouse, using Coyote Reservoir as the lower reservoir.

The purpose of this study was to investigate the economic and engineering feasibility of obtaining additional low-cost firm power for the operation of District water treatment and pumping facilities by developing hydroelectric energy at existing reservoirs or through the operation of a pumped-storage hydroelectric facility utilizing an existing reservoir.

Existing reservoirs in the District have a very limited potential for developing electric power due to limited firm flows, relatively low hydrodynamic heads and multiple-purpose flow regulation. In consideration of these limitations the generation of a large block of base power is not considered economic on County streams.

Certain District reservoirs are located adjacent to topographic features that make it possible to install pumped-storage hydroelectric facilites that pump water from a lower reservoir to a higher reservoir for later release for power generation in the peak demand periods. Such a facility located adjacent to Coyote Reservoir was considered in this study.

The pumped-storage hydroelectric facility was located adjacent to Coyote Reservoir on Timber Ridge. The upper reservoir was located on a small plateau near the top of Timber Ridge at an average elevation of 2,000 feet. The penstock, powerhouse, and tailrace were located underground in the western slope of Timber Ridge about 12,500 feet upstream from existing Coyote Dam.

Design Criteria

A. High Elevation Reservoir

1. Cut-and-fill type with rock levees concrete faced
2. Capacity, 1,780 acre-feet
3. Active storage 1,110 to 1,665 acre-feet
4. Bottom elevation, 1,980 feet
5. Water surface area at average storage level, 40 acres
6. Maximum water surface elevation, 2,015 feet

B. Existing Coyote Reservoir

1. Capacity, 24,500 acre-feet
2. Mean water surface elevation, 750 feet

3. Maximum drawdown, 5 feet

C. Tunnel and Penstock

1. A 1,160-foot vertical shaft and 3,350-foot horizontal penstock tunneled in rock

2. A 800-foot tailrace tunneled in rock

3. Penstock and tailrace dimensions-2,200 feet of 13-foot I.D. concrete-lined tunnel, 1,150 feet of steel-lined 11-foot I.D. tunnel, and 800 feet of 16-foot I.D. concrete-lined tunnel (tailrace).

D. Powerhouse and Pump-Turbine Units (Typical minimum installation)

1. Available gross head, 1,250 feet

2. Average net head, 1,200 feet

3. Design flow, 2,200 cfs

4. Capacity, 200 M.W. at 25% load factor

5. Two 137,500 HP reversible Francis-type pump-turbines

6. Powerhouse, 190' x 115' x 65' underground installation with tunnels for access

E. Transformers

1. Two 112,000 KVA step-up units in underground installation (140' x 70' x 45' room)

Operation and Generation Capacity

The basic operation consists of the pumping of water from Coyote Reservoir during off-peak periods to the high level reservoir for later release to generate electric power during peak power demand periods. The mean water level in Coyote Reservoir was established at elevation 750 feet and the upper reservoir would have an average elevation of 2,000 feet (available gross head is 1,250 feet).

Considering an active storage of 1,110 to 1,665 acre-feet a potential generation of 200 to 300 MW for an assumed maximum daily load factor of 25 percent was considered feasible. Other generation capacities at different load factors were considered possible (i.e., 400 MW at 12.5 percent daily load factor), but for preliminary estimate of typical size and cost, a 200 MW nominal capacity at 25 percent daily load factor was adopted.

Geology

The geologic investigation consisted of a review and summary of Professor C.F. Tolman's report, "Detailed Geology of the Coyote Dam Site and Geology of the Hayward and Calaveras-Sunol Faults in the Vicinity of the Coyote Dam Site", and a review of other geologic studies.

The site is located on a massive block of sandstone shale and conglomerates just easterly of the Hayward Fault. The upper reservoir is to be excavated in a massive sandstone formation. An extensive system of joints exists near the right abutment of Coyote Dam, but there is no evidence that this exists at the upper reservoir site.

The Hayward Fault passes through the Coyote Dam and Reservoir and separates the sandstone, shale and conglomerate formation to the east from the outcrop of carbonate-silica rock and serpentine to the west. A secondary fault exists near the Coyote Dam site under the stream channel. Topographic indices do not suggest seismic activity on the Hayward Fault in this area.

Construction Costs

The total estimated construction cost based on September 1968 prices was 28 million dollars. The unit construction cost for a 200 MW installation was thus estimated to be $140/KW.

The following is a breakdown of costs:

Item	Total Cost* (In Thousands)
Tunnels and Galleries	$ 4,369
Powerhouse and Transformer Room	5,695
Upper Reservoir	5,715
Pump-Turbines	6,223
Machinery and Electrical Equipment	3,492
Transformers	635
Land	190
Miscellaneous and Contingencies	1,681
Total	$28,000

*Switchyard costs have not been included.

It was estimated that a similar installation with a nominal capacity of 300 MW would decrease the unit construction cost to $125/KW.

Annual costs were not computed.

Recommendations and Conclusions

The District will be using large blocks of power for water treatment and pumping, and the possiblity of generating power for future use may be one alternative source of less expensive energy.

District reservoirs may have some potential for marginal power generation, but it does not appear that this is economic.

The development of pumped-storage facilities for the generation of power during peak demands is one alternative for providing low-cost power and a facility located near Coyote Reservoir was considered to be feasible from an engineering and unit construction cost standpoint.

In order to properly assess the feasibility of this project it was recommended that additional and more detailed work be done to better define construction costs, the marketability of power, and other engineering problems.

PROPOSAL TO RAISE EXISTING UVAS DAM

One of the alternatives considered by the Corps of Engineers in their flood control and water supply study of the Pajaro River Basin was the enlargement of the existing Uvas Dam and Reservoir. This study was made in 1965. The engineering and geologic analysis was exploritory in scope. The purpose was to establish the engineering and economic feasibility of raising the existing Uvas Dam for flood control purposes. No provisions were made for additional water conservation and recreation.

The existing dam is located on Uvas Creek about 1.8 miles upstream from the intersection of Watsonville Road and Uvas Road.

The project would consist of a raised Uvas Dam (compacted earth) a concrete lined uncontrolled spillway and extended outlet works.

Hydrology:

a) Drainage - 30 square miles

b) Reduction in standard project flood at Balsa 19,000 cfs. to 11,500 cfs. (20,000 a.f. of storage)

Dam and Reservoir Design Criteria:

a) Flood Control storage - 20,000 a.f. (total storage capacity)

b) Water Cons. Storage (existing storage capacity)-10,000 a.f.

Cost - Not Available

Conclusions: This project was not considered to be feasible and was abandoned in favor of the Gilroy site.

Remarks: Based on information contained in the Pajaro River Basin Report (draft report) and the Corps of Engineers' files in San Francisco it appears that this study was very preliminary in scope and no attempt was made to refine design criteria, establish detailed cost estimates, consider more than one purpose, establish benefits and allocate costs. Considering the information available, it is not possible to determine if this project should be studied in greater detail.

DAM AND RESERVOIR SITE ON UVAS CREEK

The name of this project is "Gilroy Dam Multi-Purpose Project". The feasibility study was made by the U. S. Army Corps of Engineers in 1965 and is a part of the larger Pajaro River Basin investigations. The engineering and geologic investigations were of the detail and scope needed for economic justification. The purpose of this investigation was to establish the engineering and economic feasibility of constructing a multi-purpose reservoir on Uvas Creek for flood control, conservation and recreation.

In investigating Uvas Creek, four dam and reservoir sites were considered: 1) the raising of existing Uvas Dam, 2) a dam on Little Arthur Creek located about 1 mile upstream from Watsonville Road, 3) a dam on Bodfish Creek about 1 mile westerly of the intersection of Watsonville Road and Highway 152, and 4) a dam on Uvas Creek (Gilroy dam site) just downstream from the confluence with Bodfish Creek at State Highway 152. The dam site selected for further study was the Gilroy site.

The Gilroy project consists of an earthfill dam on Uvas Creek with an ungated concrete ogee crest spillway located in the saddle near the left abutment and two outlet works, one an ungated facility for releasing storage above elevation 323 feet and a gated facility for low level releases. Also included is a spillway dike, a closure dike (earth filled structure) and the relocation of a portion of Highway 152 and a portion of the Watsonville Road.

The Gilroy Dam and Reservoir is a multi-purpose facility. The flood control storage pool of 23,000 acre feet would reduce the standard project flood for Uvas Creek at U. S. Highway 101 from 19,000 cfs to 5,000 cfs. With a water conservation pool of 65,000 acre feet the annual yield considering holdover and percolation is 13,800 acre feet. Without carry over this yield could be increased by 10 percent. About 1,170 acres are suitable for recreation development and for the initial project, picnic, camping, and other water-oriented facilities would be constructed to accommodate up to 660,000 visitors annually in 3 recreation areas. For recreation, the minimum storage pool is 10,000 acre feet. By providing a minimum pool of about 6,000 acre feet, a fish and wildlife enhancement benefit can be considered.

Hydrology:

a. Drainage area at dam site - 64 square miles
b. Flood discharge (inflow) - maximum flood discharge (100-year occurrence) Uvas Creek at Highway 101 - 17,000 cfs

Standard project flood (Uvas Creek at Highway 152)- 17,600 cfs
Standard project flood (Uvas Creek at Highway 101) - 19,000 cfs
Spillway design flood - 43,500 cfs

c. Flood discharge (outflow) -
Standard Project Flood - 4,600 cfs
Spillway design flood - 21,000 cfs
d. Average annual inflow - 25,400 acre feet
e. Annual Yields -
Percolation Yield (65,000 A.F. of storage) - 20,300 A.F.
Firm Yield (65,000 A.F. of storage) - 13,300 A.F.

Dam and Reservoir

a. Type of Dam - central core earth fill dam with upstream constructed of pervious materials and the downstream constructed of random material. Included is an inclined drainage blanket between core and random fill.
b. Height of dam - 124 feet (stream bed elevation - 236 feet)
c. Crest Length - 3,540 feet (elevation - 360 feet)
d. Crest Width - 20 feet; Side Slopes - 3 to 1
e. Fill Quantity - not shown
f. Freeboard - 17 feet
g. Dikes - 2 closure dikes are required, one near the spillway (50 feet high and 850 feet long) and a second at the northeastern end of the reservoir (40 feet high and 2,330 feet long).
h. Reservoir Capacity - 95,600 acre feet consisting of 23,000 acre feet for flood control, 65,000 acre feet for conservation, 6,000 acre feet as a minimum pool and 1,600 acre feet for silt storage.
i. Water surface area at spillway crest (elevation 343 feet) is 2,200 acres.
j. Spillway - fixed crest concrete ogee weir with concrete lined chute and stilling basin. 100 feet wide, with an ungated flood control outlet (4 conduits 7 feet square). Spillway crest elevation is 343 feet and outlet floor elevation is 332 feet. Maximum capacity of ungated outlet is 6,400 cfs and for combined facility is 22,000 cfs
k. Gated Outlet Works - 5 x 5 foot hydraulically operated slide gate located at the downstream end of a 6 foot diameter pressure conduit (about 760 foot long). Capacity at top of conservation pool is 1,200 cfs. Maximum capacity is 1,350 cfs. An emergency slide gate would be installed at the upstream end.
l. Diversion facilities - 5 x 5 foot slide gate at the outlet structures, capacity 150 cfs.

The total land requirement is 3,370 acres. Of this amount 2,200 acres is for the dam and reservoir project and 1,170 is for recreation lands.

The geologic investigation consisted of an aerial survey and subsurface exploration limited to the over burden materials in the embankment areas. The rocks represent marine sediments of strongly folded and faulted rock known as the Franciscan Formation and alluvial deposits exist on the valley floor area. The right and left abutments are underlain by monterey sandstone chiefly fine to medium grained and fairly hard. The overburden (sandy clay soil) is 1 to 3 feet thick on the right abutment and up to 14 feet on the left abutment. In the valley floor about 6 feet of young alluvium overlays about 72 feet of old or alluvium. The spillway is underlain by monterey sandstone with 1 to 5 feet of overburden. Monterey shales exist under the dikes at depth from about 6 to 30 feet below the ground surface. The foundation materials were considered acceptable to support the dam and dikes to the heights proposed and construction materials are available at the site.

Costs and Cost Allocation:

First Costs - Estimates of first costs based on 1964 and 1970 prices are shown below. The 1970 costs are based on the ENR index.

	1964 Costs	1970 Costs
Reservoir Lands	$ 6,200,000	$ 7,700,000
Dam and Reservoir	8,400,000	9,050,000
Relocations and Clearing	5,400,000	7,800,000
Recreation Facilities	2,200,000	3,100,000
Recreation Land	1,600,000	2,300,000
Engineering Super. & Admin.	2,800,000	3,600,000
Total Cost	$26,500,000	$32,550,000
Federal Costs	$14,350,000	-
Non-Federal Costs	12,150,000	-

Annual Costs - Estimates of annual charges were based on 1964 prices on an interest rate of 3-1/8% and for an economic project life of 100 years.

Amortization of First Cost	$ 870,000
O.M. & R.	168,000
Total	$ 1,038,000

Benefits - Benefits for flood control were based on estimates of flood damage with and without the project and land enhancement. Water supply benefits were based on a yield of 13,800 A.F. and the prices of U.S. Bureau of Reclamation water delivered at the Pacheco tunnel. Recreation benefits were based on an annual visitation of 1,300,000 in the initial year to 1,500,000 in 50 years at a value of $1.00 per visitor day. These benefits are summarized below.

Flood Control and Land Enhancement	$ 404,000	(B/C ratio 1.5)
Water Conservation	386,000	(B/C ratio 1.1)
Recreation	504,000	(B/C ratio 1.1)
Total	$1,294,000	(B/C ratio 1.2)

Cost Allocation

Allocation to Purposes

	Flood Control	Water Cons.	Recreation	Total
First Cost				
Joint Use	$ 7,700,000	$10,050,000	$4,550,000	$22,300,000
Specific Cost	--	--	4,200,000	4,200,000
Total First Cost	7,700,000	10,050,000	8,750,000	26,500,000
Percent of Total	29%	38%	33%	
Annual Cost				
Total Annual Costs	$ 263,000	$ 351,000	$ 424,000	$ 1,038,000

Allocation between interests based on 1964 prices:

Item	Federal	Non-Federal	Total
First Costs	$14,350,000	$12,150,000	$26,500,000
Interest & Amor.	470,000	400,000	870,000
O.M. & R.	21,000	147,000	168,000
Total Annual Costs	$ 491,000	547,000	1,038,000

Recommendations: The Gilroy Dam Multi-purpose project is economically feasible and should be constructed as soon as possible.

DAM AND RESERVOIR SITE ON UVAS CREEK

The name of this project is "Uvas and Llagas Creeks Project". The engineering feasibility study was done by the State Department of Water Resources as a part of their 1955 investigation of water resources and needs in South Santa Clara County (Bulletin No. 7). The investigation was preliminary and the purpose was to investigate the engineering and economic feasibility of constructing a dam and reservoir on Uvas Creek for water conservation (groundwater recharge). In addition to the dam and reservoir the overall project included a conduit to convey a portion of the water to Llagas Creek for percolation.

The damsite was located on Uvas Creek at the site of the old Gilroy Water Works Diversion Dam about 7 miles northwest of Gilroy. This is the site of the existing Uvas Dam.

The project would consist of an earthfill dam on Uvas Creek with 3 feet of rock facing on the upstream slope, a concrete lined chute type spillway (ungated) with ogee weir, a gated outlet works and the relocation of Uvas Road.

Hydrology:

a) Drainage area - 30.3 square miles.

b) Estimated safe yield (34,000 AF reservoir) is 16,300 AF.

c) Mean seasonal runoff-26,500 AF.

Dam and Reservoir Design Criteria:

a) Type of dam - earthfill dam with an impervious core and 3 feet of riprap facing (upstream side).

b) Height of dam - 157 feet.

c) Top of dam elevation - 549 feet (freeboard 15 feet).

d) Crest length - 1,255 feet, crest width of 30 feet.

e) Side slopes - 2.5:1.

f) Fill quantity - 2,250,000 CY.

g) Spillway - concrete lined chute type with ogee weir located on the left abutment. Maximum discharge depth 10 feet, capacity 20,000 cfs., crest elevation 534 feet.

h) Outlet works - 36" diameter steel pipe encased in concrete controlled at the upstream end by a 36" hydraulically operated gate valve and at the downstream end by a 30" hollow jet valve.

i) Stilling basin-12' x 12' x 60' long basin with a side gate for releasing flows into a diversion conduit.

j) The diversion conduit has a capacity of 50 cfs. and would consist of about 1.8 miles of 48" pipe and 1.5 miles of unlined canal (bottom width 5 feet, depth 2.5 feet, side slopes 1.1 in cut and 1.5:1 in fill).

k) Reservoir capacity-34,000 AF.

Geology:

Based on a preliminary geological reconnaissance of the site including an inspection of cores drilled by the South Santa Clara Valley Water Conservation District, the site was considered suitable for the construction of an earthfill dam up to a height of 200 feet. Bed rock is fine grained, slightly metamorphosed sandstone with occasional shales. About 9 feet of soil and 3 feet of weathered rock must be removed on the right abutment and about 3 feet of weathered rock must be removed on the left abutment. A suitable location for the spillway is on the left abutment ridge. This ridge is almost entirely sandstone. Construction materials are available at the site.

Costs:

Estimated first costs and annual costs based on 1954 prices and 1970 prices (based on ENR index) are shown below.

	1954 Prices		1970 Prices	
	First Cost	Annual Cost	First Cost	Annual Cost
Uvas Dam and Reservoir				
Land, Improvements and Clearing	$ 642,000	-	-	-
Dam, Spillway & Outlet Works	2,143,700	-	-	-
Admin. Cont. & Interest	818,000	-	-	-

	1954 Prices		1970 Prices	
	First Cost	Annual Cost	First Cost	Annual Cost
Uvas Dam and Reservoir (Cont'd)				
Total	$ 3,604,000	$173,000	$6,670,000	$510,000
Uvas - Llagas Conduit	274,900	16,600	506,000	44,000
Llagas Cr. Percolation Ponds	40,000	4,000	74,000	8,000
Total	$ 3,917,000	$194,100	$7,250,000	$562,000

The estimates of annual costs (1970 prices) are based on a 6% interest rate and the percentages established by the State for O.M. & R. costs.

Conclusions:

The cost per acre-foot for water including the distribution system and percolation ponds based on an annual yield of 16,300 acre-feet was estimated to be $11.90 (1954 costs). Based on this unit cost this project was considered economically feasible.

Remarks:

Based on the 1954 cost of $11.60 per acre-foot for water this project was economically feasible and possibly should have been constructed as an alternative to the project constructed by the South Santa Clara Valley Water Conservation District (storage capacity 10,000 acre-feet). With Uvas Dam constructed as a 10,000 AF storage facility it is not possible to further consider this project. However, it appears that an enlargement of this dam and reservoir as a multi-purpose facility may be economically feasible if costs are allocated to the separate purposes of water supply, flood control and recreation.

DAM AND RESERVOIR SITE ON UVAS CREEK

The name of this project is "Lower Uvas - Los Gatos Creek Project". This study was done by McKinney Associates for the Santa Clara Valley Water Conservation District in February 1958. The engineering and geologic analysis was preliminary in scope. The purpose of this study was to establish the engineering and economic feasibility of constructing a dam and reservoir on Uvas Creek to store local runoff for export to the north county area for groundwater recharge and flood control.

The dam site is located on Uvas Creek about 8 miles downstream from existing Uvas Reservoir and about 3 miles westerly of Gilroy. The conveyance facility consists of 33.2 miles of concrete lined canal and 5.4 miles of 63-inch pipe from the dam site to Los Gatos Creek near Vasona Reservoir. The alignment follows the west side of the South County groundwater basin through Uvas and Paradise Valleys to the Coyote groundwater basin near Morgan Hill and follows the Santa Teresa Hills to the northern most point. From this point the alignment follows the southerly foothills westerly crosses the Almaden Valley and continues westerly to Los Gatos Creek.

The project consists of one main dam and 3 saddle dams with the main dam located on Uvas Creek. The dams are compacted earthfill with rock facing and one concrete lined chute type spillway is located at the main dam site. In addition, the project includes a pump station, 33.2 miles of concrete lined canal and 5.4 miles of 63-inch concrete pipe.

Hydrology:

a. Drainage area - 65.7 square miles
b. Average annual discharge - 53,000 acre feet (uncontrolled)
c. Average annual discharge - 43,000 acre feet (with existing Uvas Dam and Reservoir)
d. Average annual yield (94,000 A.F. of storage) - 36,100 acre feet.
e. Supplemental yield (yield from flows intercepted by the 33.2 miles of concrete lined canal) - 2,000 to 5,000 A.F.

Dam and Reservoir Design Criteria:

a. Type of dams - earthfill with rock facing
b. Height of main dam above stream bed - 120 feet
c. Crest width - 30 feet; Crest length, main dam - 3,400 feet; Crest elevation - 356
d. Side Slopes - 2½:1
e. Fill Quantity - 3,000,000 cubic yards

f. Elevation of spillway crest - 343 feet
g. Reservoir storage (max.) 100,000 acre feet; maximum surface area - 1,750 acres
h. Conservation pool - 94,000 acre feet, dead storage - 6,000 acre feet
i. Pump Station Capacity (max.) 180 cfs., lift 110 feet
j. Canal - Concrete lined - 33.2 miles in length - Capacity - 180 cfs
k. Pipeline 63-inch I.D. concrete pipe Capacity - 180 cfs. Length is 5.4 miles.

The geologic investigation consisted of a preliminary aerial survey and the site was considered acceptable for this type of construction.

This project would be operated for both conservation and flood control. Local runoff not stored in the existing 10,000 acre feet Uvas Reservoir would be stored in this proposed reservoir during the runoff season and pumped in the off season into a diversion facility for groundwater recharge in North Santa Clara County. It was estimated that 36,100 acre feet of the average annual quantity of surplus water (about 42,000) could be economically conserved. The reservoir would be operated between a minimum storage pool of 6,000 acre feet and a maximum storage pool of 100,000 acre feet. In the 8 feet of storage space above the maximum conservation pool (about 20,000 acre feet), it was estimated that the flood peak in Uvas Creek could be reduced by 40 percent. The capacity of the spillway was not given. The diversion canal was designed to intercept runoff from streams crossed by the canal and pumping would be regulated based on recharge capacities in the North County area and the amount of water intercepted.

Costs:

The total construction cost based on 1958 prices is $12,620,000. The annual maintenance cost was estimated to be $27,000 and for operation $52,000. Repayment of the capital costs (50 years at 3½%) was estimated to be $540,000. The cost per acre foot is $17. This cost could be lowered to $13.90 per acre foot based on other possible methods of fencing.

The total construction cost based on 1970 prices is estimated to be about $21,000,000.

Conclusions:

Considering the yields from Uvas and Chesbro Reservoirs (15,700 acre feet) and the yield from the groundwater basin (estimated at 39,300 acre feet in State Bulletin No. 7) the South County has already developed conservation facilities that will meet the expected demand of 61,000 acre feet. Therefore, this diversion is surplus water that can be put to beneficial use in the North County. The project would provide a cheap source of water for recharge; is feasible and should be constructed. In addition to conservation, a large measure of flood control is possible (40% peak relocation) and a potential for recreation exists.

Comments:

In this report, the total dam and reservoir costs were assigned to water supply and no attempt was made to compute benefits and allocate a portion of this cost to the other purposes mentioned, flood control and recreation. Considering the distribution system costs plus the dam and reservoir costs allocated to water supply, this may be an economic water supply project. The Corps of Engineers in their Pajaro River Basin Study found that the construction of a multi-purpose dam and reservoir at this site was feasible. If the Corps' Project is not constructed, it appears that this site should be considered by the local interests.

DAM AND RESERVOIR SITE ON UVAS CREEK

The name of this study is "Uvas Creek Dam and Reservoir, conduit and well replenishment project proposed to be constructed jointly with the Santa Clara Valley Water Conservation District and Llagas Creek Dam and Reservoir and well replenishment project." This study was done by Blackie and Wood for the former Santa Clara Valley Water Conservation District in 1953. The dam and reservoir site on Llagas Creek was located one-half mile upstream from Lanes Bridge about three miles west of Morgan Hill. The Uvas Creek site was located at the City of Gilroy's diversion dam about seven miles west of Gilroy.

The project consists of two earthfill dams with rock facing, concrete lined chute type spillway and gated outlet works and a pipeline to divert a portion of the water stored in Uvas Reservoir to Llagas Creek for ground water recharge. Also included was the relocation of County roads.

Hydrology:

	Uvas Site	Llagas Site
a) Drainage area	27 sq. mi.	30 sq. mi.
b) Average Annual Run-off	23,700 AF (Total)	
c) Mean Annual Yield	16,500 AF (Total)	

Dam and Reservoir Design Criteria

	Uvas Site	Llagas Site
a) Type of Dam	earthfill	earthfill
b) Crest Length	1280 ft.	650 ft.
c) Height of Dam	160 ft.	90 ft.
d) Spillway	Concrete lined spillway on north abutment	Concrete lined spillway on north abutment
e) Outlet Works	gated outlet works	gated outlet works
design capacity	93 cfs	750 cfs
f) Storage Capacity		
Water supply	-	4000 AF
Flood Control	-	3500 AF
Total	34,000 AF	7500 AF
g) Conduit	2.4 miles of 48" dia. pipe & 1.7 miles of canal, capacity = 80 cfs	

Geology: The site was considered acceptable for the construction of an earthfill dam to the height proposed.

Costs:

	Uvas Dam		Llagas Dam	
	1953 Prices	1970 Prices	1958 Prices	1970 Prices
Dam and Res.	1,463,600	-	815,000	-
Road Work	135,600	-	306,000	-
Flood Control			35,000	-
Channel Work				
Land	512,000	-	400,000	-
Total	2,111,200	3,900,000	1,556,000	2,900,000

Conclusions: The project as described was considered economically feasible and should be constructed. The distribution of water and costs of the Uvas Creek project would be allocated,60% to the North District and 40% to the South District.

This project was revised in 1954 and a second report submitted entitled "Uvas Creek Dam and Water Conservation Works".

The following modifications were proposed for the Uvas Creek Dam and Reservoir.

a) height of dam 110 ft.

b) storage capacity 10,000 AF

c) conduit capacity 50 cfs.

Costs based on 1954 prices are:

Dam & Reservoir	$ 1,313,000
Relocation	445,000
Uvas-Llagas pipeline	318,000
Clearing & Creek work	35,000
Total Cost	$ 2,111,000

Conclusions:

The 10,000 acre feet reservoir and smaller dam costs are close to the amount of funds available for the construction of a facility on Uvas Creek.

Remarks:

The 7,500 acre feet facility on Llagas Creek and the 10,000 AF facility on Uvas Creek were constructed by the South Santa Clara Valley Water Conservation District. This study demonstrated that the larger 34,000 acre feet reservoir on Uvas Creek was the better alternative and should have been built if funds were available. In this analysis no attempt was made to consider flood control and recreation as separate purposes and allocate costs.

DAM AND RESERVOIR SITES ON UVAS AND LLAGAS CREEKS

The name of this study is "Feasibility Report - Utilization of Surplus Water from The Upper Llagas and Upper Uvas Creeks". The study was done by McKinney and Associates for the former Santa Clara Valley Water Conservation District and was completed in October 1957. The engineering and geologic investigation was preliminary in scope. The purpose was to establish the engineering and economic feasibility of developing the surplus water supplies on Llagas and Uvas Creeks for export to the north county area for ground water recharge.

Two dam and reservoir sites located on the main channels of Llagas and Uvas Creeks upstream from the existing facilities constructed by the South Santa Clara Valley Water Conservation District were considered. The dam site on Llagas Creek was about 2,000 feet downstream from Baldy Ryan Canyon and 1.1 miles westerly from the intersection of Casa Loma and Uvas Roads. The dam site on Uvas Creek was about 3,000 feet downstream from the intersection of Cory and Uvas Roads and about 2.8 miles upstream from existing Uvas Dam. The canal and pipeline facility follows the contours to the divide between the Calero and Llagas Creek drainages and discharges into the local creek channel.

Each dam and reservoir project consists of an earthfill dam with rock facing, concrete lined chute type spillway, gated outlet works, and the relocation of County Roads. The distribution system consists of about 1.8 miles of lined canal and pipe for the Llagas project and 8.5 miles of lined canal, pipe and a pump station for the Uvas Project. Also included is a pipeline from Calero Reservoir to Guadalupe Creek.

Hydrology:

a. Drainage Area
   Uvas Site - not shown
   Llagas Site - not shown

b. Average annual quantity of surplus water 25,000 acre feet (both sites).

c. Mean seasonal precipitation - 25 inches to 45 inches

d. Combined average annual runoff - 42,000 AF.

e. Average annual yield (combined sites) - 15,000 to 18,000 AF (includes a yield of 4,000 AF from Guadalupe drainage), the average was assumed to be 16,000 AF per year.

Dam and Reservoir Design Criteria:

		Llagas Site	Uvas Site
a.	Type of dam	earth fill	earth fill
b.	Top of dam elev.	795 feet	660 feet
c.	Side slopes	2½:1	2½:1
d.	Crest width	30 feet	30 feet
e.	Crest length	860 feet	2000 feet
f.	Height of dam	125 feet	150 feet
g.	Maximum water surface elevation	780 feet	max. 647 feet
h.	Maximum water surface area	250 acres	780 acres
i.	Storage capacity	14,000 AF	30,000 AF
j.	Total Land Regmt.	1,000 acres	
k.	Sediment storage	-	1,750 AF
l.	Fill quantity	850,000 CY	1,500,000 CY
m.	Canal Section	4' bottom 1½:1 slopes	4' bottom 1½:1 slopes
n.	Pump Station	---------	750 HP Lift 50 ft. (90 cfs) Lift 100 ft. (30 cfs)

Geology:

The geologic investigation was a preliminary aerial survey. The site was considered acceptable for the type of facility to be constructed.

Operation:

The proposed reservoirs would be operated for the conservation of local runoff that is not stored in the existing facilities on Uvas and Llagas Creeks. These facilities have a combined storage capacity of 17,500 AF, with 3,500 acre feet allocated to flood control. Surplus water would be diverted to Calero Reservoir and released into Calero Creek or delivered to Guadalupe Creek in a pipeline for ground water recharge. Considering the additional flood protection in the proposed facilities the 3,500 acre feet allocation in the existing reservoirs could be encroached upon at an earlier date for water conservation.

Costs:

Combined projects based on 1957 and 1970 prices.

Item	1957 prices	1970 prices
Dam and Reservoir	$2,600,000	-
Canals and Pipe	575,000	-
Pump Station	100,000	-

	1957 prices	1970 prices
Relocation and Access	$700,000	-
Eng., Cont., etc.	1,025,000	-
Sub Total	5,000,000	$9,250,000
Land (1000 ac.)	1,100,000	2,000,000
Other Mechanical Equipment	60,000	110,000
Total	$7,500,000	$11,360,000

Annual costs based on 1957 prices and 4% interest rates are as follows:

Annual payment on first cost (50 year life)	$346,300
Annual payment on first cost (30 year life)	3,500
Power	20,500
O & M	12,000
Total	$382,300

Unit cost of water - $23.90 per acre foot

Assuming that this project would qualify for loans under Small Dams Act, the total annual cost is $274,000 and the unit cost of water is $17.20 per acre foot.

Comparison of Costs:

South Bay Aqueduct	$17.50 to $22.50 per acre foot
U. S. Bureau of Rec.	$30.00 per acre foot
Delta Man data	$19.00 to $31.00 per acre foot
Llagas-Uvas Project	$17.20 to $23.90 per acre foot

Except for the Uvas-Llagas project, other costs must be included to make these unit costs comparable. These additional costs were not shown.

Comments:

Considering the unit cost of water ($17.20 to $23.90 acre foot), this project appears to be economically justified. Flood control benefits for the South County area could be increased and a larger yield from the 3,500 AF flood control reservation could be used for ground water recharge. Recreation could be developed at Calero based on the higher water levels maintained in Calero Reservoir and fish enhancement would exist by holding minimum pools in the proposed reservoirs.

Remarks:

Although flood control and recreation were mentioned as separate purposes, this project was developed and costs established based on a single purpose project (water supply). Based on the data presented, it appears that the benefits from flood control and recreation could be substantial if the project was designed as a multi-purpose facility. Considering these benefits and allocated costs, this project could be economically feasible and should be looked at in greater detail.

DAM AND RESERVOIR SITE ON ZAYANTE CREEK IN SANTA CRUZ COUNTY

The name of this project is "Zayante Project". The engineering feasibility study was done by the State Department of Water Resources as a part of their 1955 investigation of water resources and needs in Santa Clara County (Bulletin No. 7). The investigation was preliminary and the purpose was to investigate the engineering and economic feasibility of constructing a storage facility on Zayante Creek in Santa Cruz County and diverting the water through a series of tunnels to Santa Clara County.

The damsite is located on Zayante Creek about 5.0 miles upstream from its confluence with the San Lorenzo River.

The dam and reservoir project would consist of an earthfill dam with a 3-foot rock facing, concrete chute type ogee weir spillway (ungated) and gated outlet works. The overall project would include a pump station and conduit to export water to Los Gatos Creek in Santa Clara County.

Hydrology:

a) Drainage area-9.5 square miles.

b) Mean seasonal runoff-9,000 AF.

c) Safe seasonal yield (storage capacity of 6,900 AF)-4,000 AF.

d) Design flood-8,900 cfs.

Dam and Reservoir Design Criteria:

a) Type of dam-earthfill with impervious core and 3-foot riprap facing.

b) Height of dam above stream bed-140 feet (stream bed elevation-475 feet).

c) Crest length-470 feet, crest width 28 feet and a crest elevation-616 feet.

d) Side slopes 2.5:1.

e) Fill quantity-433,800 CY.

f) Reservoir capacity-6,900 AF (Water surface area 153 Ac).

g) Spillway-concrete lined chute type with ogee weir located on the right abutment. Design capacity 8,900 cfs. Maximum depth of water over crest-8 feet, weir elevation-603 feet.

h) Freeboard-13 feet above spillway lip.

i) Outlet works-36" diameter steel conduit with an upstream inclined intake structure. Flow would be controlled by 4 hydraulically operated 18" valves in the inclined intake structure.

Pump Station and Conduit

Pump Station - 3 centrifugal pumps, total capacity 20 cfs., maximum pumping head 472 feet. Installed horsepower 1350.

Conduit - 6.4 miles of 30" welded steel pipe discharge capacity 20 cfs.

Geology:

The dam and reservoir site is in the Vaqueros formation. The Strata is fine gravel sandstone and silt stone with inclined layers of shale (8" thick). Stripping should not exceed 6 feet of overburden and 4 feet of fractured rock on the right abutment and 5 feet of overburden and 2 feet of rock for the left abutment. Suitable construction material exist about 2 miles downstream. Material for riprap would have to be hauled about 4 miles.

Costs:

Estimated first costs and annual costs based on 1954 and 1970 prices are summarized below:

	1954 Prices		1970 Prices*	
	First Cost	Annual Cost	First Cost	Annual Cost
Dam and Reservoir	$1,299,400	$63,000	$2,400,000	$180,000
Pump Station	120,200	47,300	222,000	60,000
Pipeline	1,237,600	69,100	2,400,000	210,000
Total	$2,657,200	$179,400	$5,022,000	$450,000

The 1954 cost of water per acre-foot is $45.

* First cost based on ENR index and annual costs based on 6% interest plus OM&R costs.

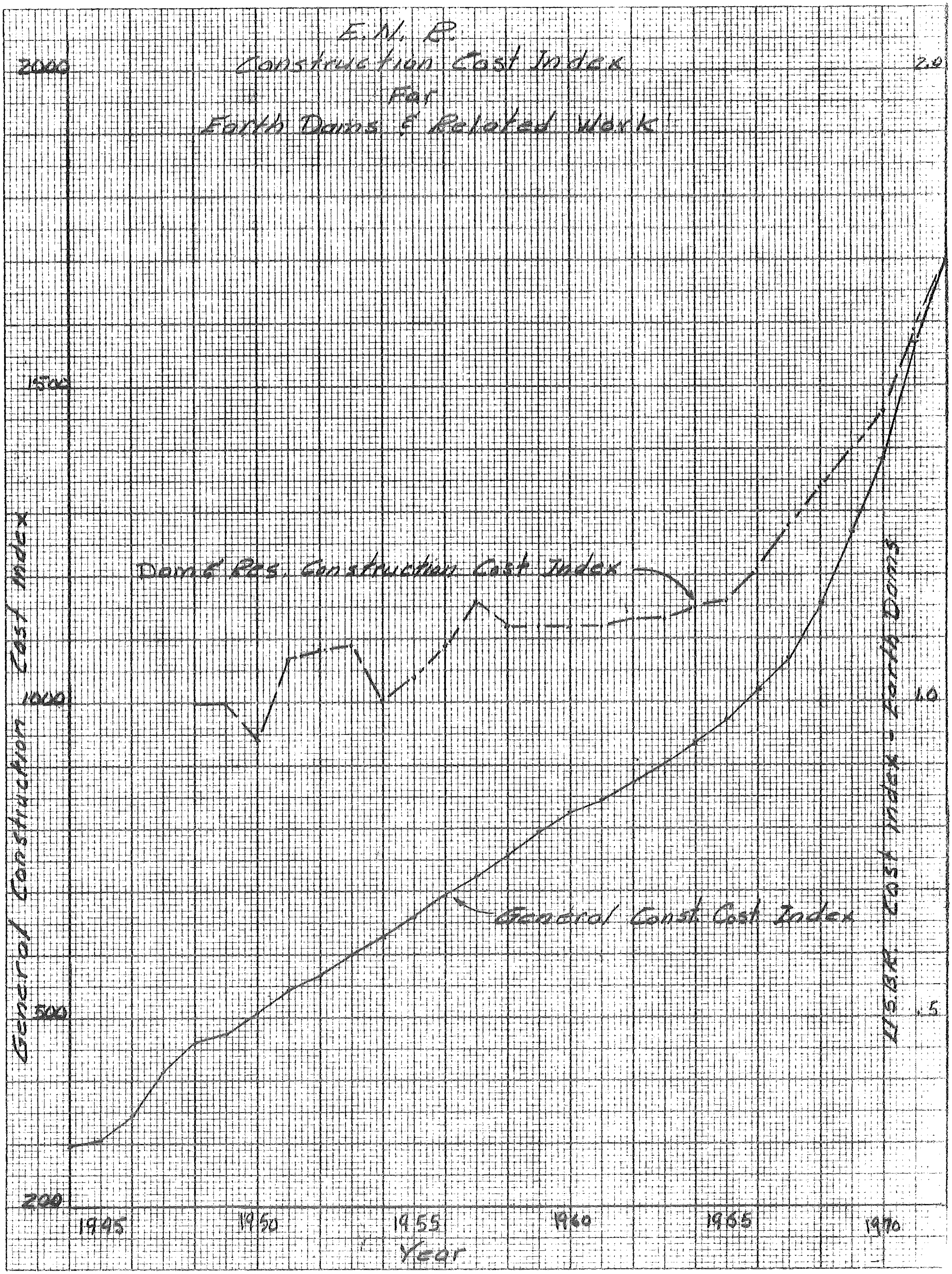
Conclusions:

This project was considered to be uneconomic and that consideration should be given to other means of obtaining supplemental water.

Remarks:

The cost of water from this facility based on 1970 prices is close to $110/AF, based on the States' estimate of O.M.& R. and a 6% interest rate. This cost is too high to economically justify the project as a single-purpose project. By considering recreation and flood control as separate purposes and allocating costs, the unit cost of water could be lowered.

APPENDIX


E.N.R.
Construction Cost Index
For
Earth Dams & Related Work
2000
1500
1000
500
200
2.0
1.0
.5
General Construction Cost Index
USBR Cost Index - Earth Dams
Dams & Res. Construction Cost Index
General Const. Cost Index
1945
1950
1955
1960
1965
1970
Year